RESIDENTIAL KITCHEN FLOOR PLAN OPENNESS, SOCIAL FAMILIARITY, AND EATING BEHAVIORS

A Thesis

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by

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ABSTRACT

In the context of the obesity epidemic, understanding environmental influences on eating patterns is critical. This study examined the effects of one built and one social environmental feature on three eating behaviors during a buffet-style meal: number of serving trips, amount of food and beverage served (grams and calories), and amount of food and beverage consumed (grams and calories). The within-subjects independent variable, kitchen floor plan openness, had two levels (open and closed) which were manipulated by placing folding screens in a test kitchen with open floor plan (where food and external eating cues were more salient) to convert it into a “closed” kitchen with no view of kitchen appliances, counters, or food. The between-subjects independent variable, social familiarity, was operationalized by participant dining group composition: friends versus strangers. A repeated measures, 2x2 factorial study was conducted with 57 college students in a test kitchen.

Statistical analyses were conducted using a linear mixed model procedure to examine both main effects of and interactions between kitchen floor plan openness and social familiarity on three eating behaviors, as well as how these effects were moderated by education level, gender, hunger, social interaction, ethnicity, income, housing type, age, BMI, dining group size, serving trips (dependent variable: amount served), and amount served (dependent variable: amount consumed). All predictors, except for ethnicity, income, housing type, and age, were significant in at least one model. Findings suggested that dining in the open condition was associated with an increase in serving trips, but effects were moderated by main effects of and various interactions between social familiarity, education level, gender, social interaction, BMI, and dining group size. Dining with strangers was also associated with an increase in serving trips and amount consumed (grams), but effects were moderated by main effects of and some interactions between education level, gender, social interaction, dining group size, and amount served. Findings suggested that floor plan openness influenced serving trips, and social familiarity affected serving trips and amount consumed. Study strengths, limitations, and suggestions for future work are also discussed.

BIOGRAPHICAL SKETCH

Kimberly (Kim) Rollings was born in Chicago Heights, Illinois. She spent her childhood in Matteson, Illinois with her parents and younger brother before attending college at the University of Notre Dame in South Bend, Indiana. When Kim was not in architecture studio or volunteering with service projects, she actively participated in campus music programs and served as a drum major for the University of Notre Dame Marching Band. She also enjoyed her required year abroad to study architecture in Rome, Italy, before graduating with a Bachelor of Architecture degree in 2003. Kim and her husband met as Notre Dame Band flute and piccolo players, and later returned to Notre Dame to marry in June, 2008.

Before beginning graduate school at Cornell, Kim was employed as an architect for primarily residential architecture firms. She also completed research methods and architecture and human behavior courses at Columbia University and the University of Wisconsin-Milwaukee. After working as a project architect in New York City, Kim joined Cornell's graduate program in Design and Environmental Analysis full-time to explore interests in architecture and health. Upon completing her thesis, she will remain at Cornell to pursue a doctoral degree in Human Behavior and Design. In the future, Kim would like to teach environment-behavior courses and design studios in an architecture department, and continue to research the built environment and health.

To my patient husband and supportive parents,

and in loving memory of my grandmother

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Lastly, I express sincere love and gratitude to my husband, parents, family, and friends who patiently encourage and endure my seemingly never-ending search for an academic career.

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CHAPTER 1

INTRODUCTION AND REVIEW OF THE LITERATURE

Introduction

Overweight, obesity,[3] and related chronic diseases have reached epidemic levels. Adult obesity rates have doubled and childhood rates have tripled in only 30 years. More than two-thirds of American adults 20 years and older are now overweight, and 34 percent of those adults are considered obese (Flegal, Carroll, Ogden, & Curtin, 2010); nearly one-third of American children and adolescents are also overweight or obese[4] (Centers for Disease Control and Prevention, 2010). The average American adult gains between one and two pounds per year throughout much of adulthood (Kushi et al., 2006; U.S. Department of Health and Human Services & U.S. Department of Agriculture, 2005). Numerous environmental factors, ranging from global food systems and transportation to portion and plate sizes, and advanced modern conveniences that afford cheap access to large quantities of food and require less physical activity are among the many contributors to weight gain and the current obesity epidemic.

The obesity crisis is particularly concerning because of the negative physical, social, and mental health consequences associated with obesity (Must et al., 1999). Annual costs of treating obesity-related illnesses and conditions are expected to exceed an estimated 112 billion dollars in direct and indirect costs (Centers for Disease Control and Prevention, 2010). Today's youth may be the first modern Western generation to not outlive their

[3] Overweight is defined as a body mass index (BMI) above 25, and obese is above 30.
[4] The Centers for Disease Control and Prevention does not use the term "obese" for children.

parents (Olshansky et al., 2005), a prediction strongly directing research efforts towards reducing the prevalence of obesity. Understanding how environmental factors have contributed to the increase in caloric intake and decrease in physical activity is critical. Decreasing calorie consumption by as little as 50 to 100 calories per day, in addition to increasing daily physical activity by 2,000 steps or a 15- to 20-minute brisk walk, could reduce or even avoid annual weight gain (Hill, Wyatt, Reed, & Peters, 2003; Kushi, et al., 2006; U.S. Department of Health and Human Services & U.S. Department of Agriculture, 2005).

Bronfenbrenner's Ecological Model. Understanding how social, dietary, physical, environmental, genetic, and economic factors affect weight gain proves a difficult task (Bray, Bouchard, & James, 1998; Killingsworth, Earp, & Moore, 2003; World Health Organization, 1998; Zhang & Wang, 2004a). Ecological models provide frameworks for conceptualizing complex factors, such as those influencing poor diet and physical inactivity (Wells, Ashdown, Davies, Cowett, & Yang, 2007; Wells & Olson, 2007). Bronfenbrenner's ecological model of human development (Figure 1) identifies four scales of our surrounding material environment, or "context," that can be utilized to better understand environmental influences and interactions between factors at various scales on obesity: *microsystem, mesosystem, exosystem*, and *macrosystem* (Bronfenbrenner, 1979, 1994). The *chronosystem* further acknowledges changes or consistency in both individuals and environments over time (Bronfenbrenner, 1994). The intent of this model was to examine interactions between the various scales.

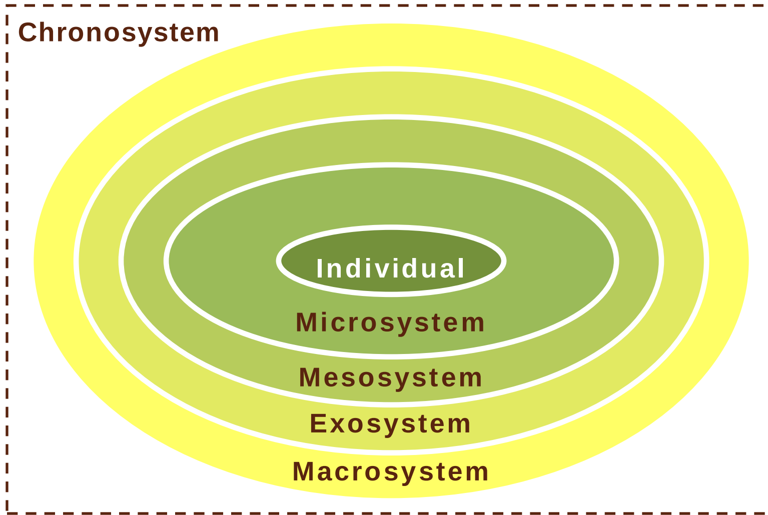

Figure 1. Bronfenbrenner's Ecological Model

A *microsystem* is a pattern of relationships and interactions between individuals and their immediate surroundings, such as families at home or coworkers in a workplace (Bronfenbrenner, 1979, 1994). These interactions, known as proximal processes, are defined as regularly reoccurring interactions between an individual and other physical, social, and symbolic environmental features necessary for human development (Bronfenbrenner, 1994; Wells & Rollings, under review). *Meso*-, *exo*-, and *macrosystems* are other contexts that affect development beyond microsystems. *Mesosystems* are relationships between two or more microsystems (e.g., home and school, each containing the individual. *Exosystems* are comprised of interactions between two or more settings, where at least one setting does not include the individual but indirectly influences proximal processes within other immediate settings (e.g., for a child, his/her home and a parent's place of work). *Macrosystems* are broad societal patterns of micro-, meso-, and exosystems (e.g., economy, government, and cultural values that refer especially to a culture or subculture's typical beliefs, knowledge, resources, customs, and life-styles (Bronfenbrenner, 1994).

As concerns regarding the obesity epidemic have increased and its complexities have become apparent, Bronfenbrenner's ecological model (Bronfenbrenner, 1979) has provided a critical foundation for obesity research (Sallis, Bauman, & Pratt, 1998). By recognizing influences of and interactions between individual, familial, environmental, societal, and policy-related factors, the ecological perspective suits the challenging and interdisciplinary issues at various scales surrounding the obesity epidemic. The ecological framework, furthermore, aligns with current approaches utilized by the field of public health and related disciplines. Recently, focus has shifted from an individually-centered, educational intervention approach toward an emphasis on larger-scale environmental and policy factors, in addition to cross-scale interactions, as strategies to promote healthy habits (Sallis, et al., 1998).

Understanding influences of and interactions between the physical and social environments on eating patterns is particularly urgent in the context of the obesity epidemic. Characteristics of both the built and social environment, along with individual factors, within a microsetting can affect eating behaviors. The primary objective of the present study was to examine influences of and interactions between individual (e.g., age and gender) and micro-level environmental factors (one built and one social) within residential kitchens on three eating behaviors: number of serving trips, amount of food and beverage served,[5] and amount of food and beverage consumed. Before discussing the current study, the following three sections review literature concerning macroscale influences of socioeconomic status and demographic correlates of obesity, microscale influences of the built environment within kitchens on

[5] Participants served themselves all food and beverage items.

eating behaviors, and microscale influences of the social environment within kitchens on eating behaviors.

Macroscale Environmental Influences: Socioeconomic Status and Demographic Correlates of Obesity

Previous studies have indicated that the prevalence of obesity is associated with various demographic factors. A growing body of evidence has reported disparities in obesity across socioeconomic status (SES), age, education level, ethnicity, and gender (Borders, Rohrer, & Cardarelli, 2006; Chang & Lauderdale, 2005; Kumanyika, 1987, 1999; Ogden et al., 2006; Sundquist & Johansson, 1998; Y. Wang & Beydoun, 2007; Y. Wang & Zhang, 2006; Winkleby, Kraemer, Ahn, & Varady, 1998; Winkleby, Robinson, Sundquist, & Kraemer, 1999; Zhang & Wang, 2004a). In the United States, obesity rates are more prevalent among low education levels, minorities, and other disadvantaged groups (Dreeben, 2001; Flegal, Carroll, Kuczmarski, & Johnson, 1998; Gordon-Larsen, Adair, & Popkin, 2003; Mokdad et al., 2003; Schoenborn, Adams, & Barnes, 2002).

SES is associated with several factors linked to both dietary intake and energy expenditure (Evans, Wells, & Schamberg, 2010). Low-income populations typically consume high amounts of fat and participate in less physical activity (Evans, et al., 2010). Access to healthy foods, exercise facilities, and health care services are also linked to SES and can influence the prevalence of obesity (Zhang & Wang, 2004a). Because the relationship between obesity and SES is both confounded by and interacts with education, age, gender, and ethnicity, these correlated variables must be measured when studying environmental influences on eating and physical activity behaviors associated with obesity (Zhang & Wang, 2004a). The following sections discuss demographic disparities in obesity, with particular attention to the complex relationship between obesity, SES, age, education, gender, and ethnicity.

Education, age, and SES. Education, income, occupation, and class culture are measures of SES. Obesity rates have been linked to education, a dimension of SES (Drewnowski, Rehm, & Solet, 2007), but education and age are also often correlated (Y. Wang & Beydoun, 2007). Analysis of the 1999-2000 National Health and Nutrition Examination Surveys (NHANES) data found that Americans with less than a high school education had a higher prevalence of obesity than those with at least a high school education[6] (Y. Wang & Beydoun, 2007). The same data also indicated that more than 70% of Americans aged 60 years or older were overweight or obese, regardless of gender (Y. Wang & Beydoun, 2007).

Gender and SES. Obesity patterns differ among men and women (Borders, et al., 2006). Women of high SES were significantly less likely to be overweight than women of low SES, but the reverse was true for men (Zhang & Wang, 2004a). Low-SES men had a lower risk for obesity because they typically held more physically demanding jobs than high-SES men (Wardle et al., 1999). Additionally, attitudes toward body weight often differ by gender, especially in developed societies, and thus affect men's and women's respective eating and physical activity patterns differently (Sobal & Stunkard, 1989). Studies have shown that women in most Western societies view

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[6] This was true for all groups except African American women. Higher education levels experienced a higher prevalence of obesity compared to those with less than a high school education (Y. Wang & Beydoun, 2007).

obesity more negatively than men (Cahnman, 1968; DeJong, 1980; Wardle & Griffith, 2001).

Ethnicity and SES. While obesity rates in the U.S. have increased across all levels of SES during the past 30 years, people of low SES have not always experienced the largest gains (Chang & Lauderdale, 2005). Various ethnic groups have been affected disproportionately. For example, middle- and low-income African American women experienced a 27% (1.05% per year) and 14.5% (0.54% per year) increase, respectively, while high- and low-income African American men experienced 21.1% (0.77% per year) and 5.4% (0.50% per year) increases between 1971 and 2002 (Chang & Lauderdale, 2005). Current obesity rates still reflect ethnic disparities, displayed in Table 1 from the U.S. Census Bureau's Behavioral Risk Factor Surveillance System (BRFSS) surveys, which assessed the prevalence of obesity by gender and ethnicity in 2006-2008 (Centers for Disease Control and Prevention, 2009).

Table 1. Prevalence* of Obesity+ Among Adults by Ethnicity and Gender
Behavioral Risk Factor Surveillance System surveys, United States, 2006−2008 (Centers for Disease Control and Prevention, 2009)

Ethnicity	White, non-Hispanic (n = 900,629)		Black, non-Hispanic (n = 84,838)		Hispanic (n = 63,825)	
Gender	%	(95% CI^)	%	(95% CI)	%	(95% CI)
Men	25.4	(25.1--25.7)	31.6	(30.6--32.7)	27.8	(26.7--28.9)
Women	21.8	(21.6--22.1)	39.2	(38.5--40.0)	29.4	(28.5--30.3)
Total	23.7	(23.5--23.9)	35.7	(35.0--36.3)	28.7	(28.0--29.5)

** Age adjusted to the 2000 U.S. standard population.*
+ Body mass index (BMI) ≥30.0; BMI was calculated from self-reported weight and height
^ Confidence interval

Minority populations continue to experience higher obesity rates. Currently, 77% of black women are overweight or obese, and 15% are considered "extremely obese" (BMI $\geq$ 40) (Flegal, Carroll, Ogden, & Johnson, 2002). There is a higher prevalence of obesity among black women than white women at all levels of education and income (SES indicators) (Winkleby, et al., 1998). Whites experienced a negative association between SES and obesity regardless of gender, but gender differences exist among black and Mexican American populations (Zhang & Wang, 2004a).

Other studies have also examined obesity using both SES and ethnicity as predictors (Ogden, et al., 2006; Robert & Reither, 2004; Y. Wang & Beydoun, 2007; Y. Wang & Zhang, 2006; Zhang & Wang, 2004a, 2004b). Disparities in obesity could be explained by factors distinct from SES, such as body image, lifestyles, and social and physical environments associated with ethnicity. Obesity may negatively affect education, job, and marriage opportunities, creating a bidirectional causal relationship between SES and obesity (Gortmaker, Must, Perrin, Sobol, & Dietz, 1993). Low income geographical areas are often characterized by a lack of grocery stores and a surplus of fast-food restaurants, also contributing to SES and ethnic disparities (Morland, Wing, & Diez Roux, 2002; Pothukuchi, 2005). Macroscale influences of SES and demographic correlates of obesity must be considered when researching obesity and eating behaviors at smaller scales, such as the microscale.

Microscale Influences of the Built Environment

The built environment includes anything humans create within the numerous settings where people obtain and eat food (e.g., home, school, workplace, restaurants, and supermarkets) (Bartuska & Young, 1994; Story, Kaphingst, Robinson-O'Brien, & Glanz, 2008). Built environments at the microscale, and objects within them, can affect the type and amount of food and beverage people both serve and consume (French, Story, & Jeffery, 2001; Sobal & Wansink, 2007).

Many studies of the built environment and obesity have focused on a narrow portion of the full range of environmental scales (Sobal & Wansink, 2008). Previous research has mostly examined either macro-scale issues (e.g., food systems, food access, and neighborhoods and communities), or only the physical activity side (e.g. neighborhood design, transportation, sidewalks) of the energy balance equation, and neglected environmental influences on diet (Sobal & Wansink, 2008; Wells, et al., 2007). Obesity is fundamentally caused by an energy imbalance. The energy balance perspective recognizes that the way to achieve a healthy body weight is to balance energy intake (food and beverage consumption) with energy expenditure (physical activity) (Hill & Peters, 1998; Hill, et al., 2003; U.S. Department of Health and Human Services & U.S. Department of Agriculture, 2005; Vainio & Bianchini, 2002; Wells, et al., 2007). A handful of previous studies have investigated the influences of the built environment, such as locations of grocery stores and fast food restaurants, on dietary intake and BMI at the neighborhood scale (Gallagher, 2006; Ghirardelli, Quinn, & Foerster, 2010; Inagami, Cohen, Finch, & Asch, 2006; Jeffery, Baxter, McGuire, & Linde, 2006; Powell, Auld, Cahloupka, O'Malley, & Johnston, 2007; M. C. Wang, Kim, Gonzales, MacLeod, & Winkelby, 2007; Wrigley, Warm, & Margetts, 2003), but little attention has focused on elements of built environments and dietary intake at other levels of environmental scale, especially microscales (Sobal & Wansink, 2008; Wells, et al., 2007), beyond plate and portion sizes and ambient environmental characteristics (Sobal & Wansink, 2007, 2008; Wansink, 2004).

Sobal and Wansink (2007) proposed that characteristics of the built environment that affect dietary intake within microsettings can be further classified into four scales: *foodscapes*, *platescapes*, *tablescapes*, and *kitchenscapes*. *Foodscapes*, in the context of eating environments, are the smallest-scale items of the built environment and describe the view or appearance (e.g., size, volume, shape, texture, and color) of a particular food or beverage item that will be consumed (French, et al., 2001; Sobal & Wansink, 2007). This appearance can affect portion size judgment and intake (French, et al., 2001; Sobal & Wansink, 2007). *Platescapes* consist of the next smallest-scale items within a microsetting related to eating, such as food and beverage containers, food and beverage packaging, plates, bowls, glasses, and other utensils. Shape, size, and transparency can affect how much people serve: they eat and drink more from larger or more transparent containers, and larger glasses, serving utensils, and food packaging (Wansink, 1996; Wansink, Cardello, & North, 2005; Wansink & Cheney, 2005; Wansink & Kim, 2005; Wansink, Painter, & North, 2005; Wansink & Van Ittersum, 2003, 2005; Wansink, Van Ittersum, & Painter, 2006). Because people typically consume an estimated 92% of what they serve themselves, platescapes greatly influence dietary intake (Wansink & Cheney, 2005).

Tablescapes describe surfaces and furniture from which food and beverage can be served and consumed (Sobal & Wansink, 2007). The salience (visibility) and convenience of food and beverage affect consumption at the tablescape level. Items within closer proximity or of greater salience can lead to higher consumption (Painter, Wansink, & Hieggelke, 2002; Wansink, Painter, & Lee, 2006). People are similarly affected by the size, shape, and transparency of serving containers at the tablescape level: they serve themselves more when using larger serving containers, plates, glasses, and other utensils (Wansink, 1996; Wansink, Cardello, et al., 2005; Wansink & Cheney, 2005; Wansink & Kim, 2005; Wansink, Painter, et al., 2005; Wansink & Van Ittersum, 2003, 2005; Wansink, Van Ittersum, et al., 2006). The arrangement of food on a surface also affects serving size: organized layouts lead to smaller serving sizes than cluttered or disorganized patterns (Kahn & Wansink, 2004).

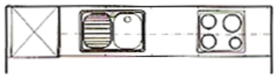
Rooms for preparing, serving, and consuming foods within architectural structures are known as *kitchenscapes* (Sobal & Wansink, 2007). Behavior settings are created within rooms where food and beverage are consumed, such as kitchens, and contain patterns of and cues for eating (Barker, 1968). When these cues are more salient within a setting, food and beverage intake can increase due to a lack of cues that suggest when to stop consumption (Sobal & Wansink, 2007). Additionally, the ambience of the kitchenscape also affects cues related to eating (Stroebele & de Castro, 2004). Lighting, color, sound, smell, temperature, overall ambiance, and other interior characteristics, in addition to social cues and both built and social distractions within a room, can also influence food and beverage consumption (Stroebele & de Castro, 2004). Salience and convenience of food and beverages within a room also affect food and beverage consumption at the kitchenscape scale (Painter, et al., 2002; Wansink, Painter, et al., 2006).

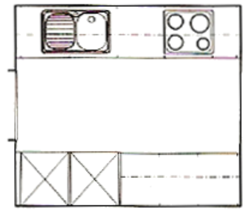
While studies have examined influences of the built environment on food consumption at the table- and platescape levels within microsettings (e.g., plate and portion sizes), and ambient environmental elements such as lighting and décor in restaurants at the kitchenscape scale (Sobal & Wansink, 2007, 2008; Wansink, 1996, 2004; Wansink, Cardello, et al., 2005; Wansink &

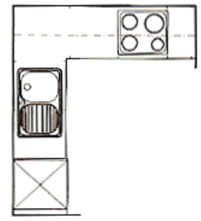
Cheney, 2005; Wansink & Kim, 2005; Wansink, Painter, et al., 2005; Wansink & Van Ittersum, 2003, 2005; Wansink, Van Ittersum, et al., 2006), little attention has focused on influences of residential kitchenscapes, especially floor plan, on dietary intake. Floor plans of residential kitchens and homes are changing, becoming larger, less enclosed, and more centralized (Hasell & Peatross, 1990), which may food and beverage-related cues and therefore, eating behaviors.

In order to understand how environmental factors within the kitchenscape, such as floor plan, affect eating behaviors, it is useful to briefly consider the history of residential kitchen design. Evolving kitchen floor plan designs changed the salience and convenience of food and beverage within residential settings. The following sections first briefly discuss the history of residential kitchen design in the U.S., then present evidence linking eating behaviors to salience and convenience of food and beverage.

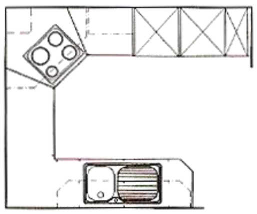
Residential kitchen design in the U.S. Today's typical residential kitchens have evolved from enclosed work rooms (e.g., plan B., Figure 2) used mostly by women to open, multifunctional family spaces that are often centrally located within a home (e.g., plans D. and E., Figure 2). Both the layouts of cabinetry and appliances within kitchens and the enclosure of kitchen spaces have changed in response to evolving family needs.

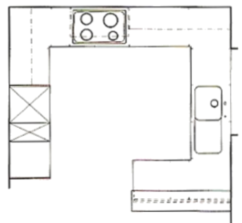


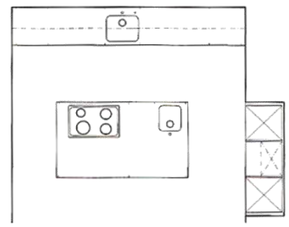




A. Single-wall kitchen *B. Galley kitchen* *C. L-shaped kitchen*







D. U-shaped kitchen *E. G-shaped kitchen* *F. Island kitchen*

Figure 2. Kitchen Floor Plan Types (Spechtenhauser, 2006)

While transitions in kitchen design can be attributed to multiple factors, the feminist movement was one of the most influential. Housing needs and changing gender roles in the United States, beginning especially after World War II, elicited changes in American housing development. Small post-war homes, often below one thousand square feet, were quickly constructed to meet mass demands for low-cost housing (Hasell & Peatross, 1990). Within these homes, room sizes were decreased or removed from floor plans: dining rooms merged with kitchens or living rooms, closet space was reduced, and basements and utility space were eliminated. Housing size increased only slightly (to 800-1200 square feet) during the 1950s, but did not significantly grow until the 1970s and 1980s (average home size of 2400 square feet or more).

This increase in housing size evolved from the failure of quickly constructed post-war housing to support an increasing number of dual income family lifestyles: families had more money, less time, and less-defined gender roles within the home. Women, especially, sought more open, multifunctional residential floor plans with combined kitchen, family room, and eating areas where they could prepare meals, share domestic responsibilities, supervise children, and maximize time spent with family while multitasking (Hasell & Peatross, 1990; Miller & Maxwell, 2008; Plante, 1995). Builders and architects responded to these needs by converting enclosed,[7] cramped, and segregated kitchen "work rooms" into larger, more open and more multifunctional spaces. A content analysis study which examined prototypical house plans in a home service magazine between 1945 and 1985 found that 75% of kitchens were enclosed between 1945-1955, 31% between 1960-1970, and 50% between 1975-1985 (includes remodels of older homes that remained enclosed but were extensively changed) (Hasell & Peatross, 1990). Total kitchen space also increased from an average of 107 square feet in 1945 to 201 square feet in 1985 (Hasell & Peatross, 1990). The kitchen became somewhat of a stage for those who could afford to entertain. Other homeowners desired more storage space, or focused on transforming the kitchen "work room" into a living space with architectural details and interior decoration. In the 1980's and 1990's, kitchens began to include a television, desk or computer area, and multiple seating areas (Plante, 1995). Household behavior began to change because open kitchens supported convenience, efficiency, comfort, and sharing of responsibilities.

[7] Room enclosure is defined by "full-height walls and/or doors or windows segregating a room from other areas of a house… (a) kitchen is considered open when it was part of another room or partially separated by an open counter or half wall" (Hassell & Peatross, 1990, p. 17).

Salience and convenience of food. Understanding how environmental factors within kitchens, especially at the kitchenscape scale, influence individual eating behaviors is important because these factors directly affect food and beverage salience and convenience. Salience (visibility) and convenience of food and eating-related external cues have been linked to increased food consumption (Chandon & Wansink, 2002; Painter, et al., 2002; Sobal & Wansink, 2007, 2008; Wansink, 2004; Wansink & Deshpande, 1994; Wells, et al., 2007). Evolving kitchen designs affected both the salience and convenience of food within the kitchenscape, yet how these changes affected eating behaviors is unknown. Furthermore, more than one person can also comfortably and simultaneously complete tasks in an open kitchen, such as preparing food, doing homework, or eating, so more time at home is spent in the kitchen where more salient foods and beverages are present. Evidence has shown that more salient foods and beverages are consumed more frequently (Painter, et al., 2002; Wansink & Deshpande, 1994). Kitchens display food and beverages in various open, closed, clear, and opaque bowls, dishes, boxes, and other containers (Sobal & Wansink, 2007). Open kitchens can also be more visible within a home and, therefore, increase the salience of food, beverage, and external cues related to eating.

Centralized, open kitchens also increase convenience by reducing the number of steps (effort) required to access them from other areas in a home. Floor plan arrangements can even force residents to pass through the kitchen space in order to access other rooms. More conveniently accessible foods can increase the amount and frequency of consumption (Engell, Kramer, Malafi, Salomon, & Lesher, 1996). Effort is one of the strongest influences on food and beverage consumption (Levitsky, 2002; Wansink & Deshpande, 1994).

Studies found that moving a candy dish away by six feet and increasing effort required to access it (decrease convenience) reduced consumption by half (Wansink, Painter, et al., 2006). Conversely, people consumed more water when pitchers were placed on the table instead of elsewhere (Engell, et al., 1996). Additionally, storage of food and beverages, especially convenient and ready-to-eat items, in pantries, cabinets, and on shelves within kitchenscapes was also associated with an increase in intake (Chandon & Wansink, 2002). Although kitchen floor plans and placement within a home can also affect the convenience of accessing food and beverage, this study focused on how kitchen floor plans affect food and beverage salience.

In addition to food and beverage salience, social determinants can also shape dietary intake within the kitchenscape (Sobal & Wansink, 2007). Residential kitchens are often shared by families, house mates, and roommates. Microscale influences of the social environment, such as attributes of and processes involving eating companions discussed in the following section, can both facilitate and hinder eating behaviors.

Microscale Influences of the Social Environment

The social environment consists of relationships with, attributes of, and interactions between family, friends, classmates, coworkers, peers, and community members (Story, et al., 2008). Previous research has indicated that dining companions also affect eating behaviors through the processes of self-presentation and conformity, in addition to the attributes of gender and social familiarity (Clendenen, Herman, & Polivy, 1994; de Castro, 1994a, 1994b, 2000; de Castro & de Castro, 1989; Salvy, Jarrin, Paluch, Irfan, & Pliner, 2007). *Self-presentation* is the process of adjusting one's behavior to communicate a message, by what and how much one eats in the context of eating behaviors, to any audience present (Salvy, Jarrin, Paluch, Irfan, & Pliner, 2007). Social norms and cues can influence the message conveyed while eating. People may adjust their consumption in the presence of others to conform to others' behaviors and expectations, or to present an image (e.g., appearing feminine by inhibiting intake). *Conformity* studies showed that participants ate more when with a confederate, partner, or group who consumed larger amounts (Goldman, Herman, & Polivy, 1991; Herman, Roth, & Polivy, 2003; Roth, Herman, Polivy, & Pliner, 2001). The number of (dining group size), social familiarity among, and gender of eating companions also moderated an individual's intake.

Dining group size. People consumed more food and beverage in the presence of others than when alone (de Castro, 1990, 1994a; Hetherington, Anderson, Norton, & Newson, 2006), regardless of location, time of day, weekday or weekend, and presence of alcohol or snacks (de Castro, 1991; de Castro, Brewer, Elmore, & Orozco, 1990). Meals consumed with just one other person were 33% larger (de Castro, 2000) than those consumed alone, and consumption further increased by 47-96% when eaten with 2-7 more people (de Castro & Brewer, 1992). Conversely, other studies found that people inhibited food intake when eating with others (Mori, Chaiken, & Pliner, 1987; Pliner & Chaiken, 1990). This was perhaps because characteristics of the meal, setting, and others present likely moderated the effects of others on an individual's consumption. The mechanisms by which eating companions affect an individual's eating behavior are unknown. Eating with other people, especially friends, can lead to a longer meal time (Bell & Pliner, 2003). Observing others' eating behaviors can also provide a consumption norm or offer a distraction that prevents an individual from monitoring consumption and satiety (Birch & Fisher, 2000; de Castro, 1994a; Wansink, 2004).

Social familiarity and gender. Social familiarity and gender moderate the effects the presence of others has on consumption. When dining with friends, previous studies found that consumption increased, especially when the meal was more relaxing, enjoyable and long; the group dining experience could have reduced individual ability or motivation to monitor consumption (Wansink, 2004). Eating with unfamiliar people, on the other hand, could decrease consumption when self-monitoring and self-awareness are high, such as when on a date or in the presence of a desirable mate (Mori, et al., 1987; Pliner & Chaiken, 1990). The degree of familiarity among eating companions, however, also moderates consumption. Effects on consumption are stronger when eating with friends, family, or a spouse, but not when eating with classmates, coworkers, or strangers and other less familiar companions (Clendenen, et al., 1994; de Castro, 1994a). Close friends and family eating with each other may be less concerned by their self-presentation or image, and therefore eat more (Salvy, et al., 2007).

Gender and social norms relating to gender also moderate consumption. Men and women both value socially desirable eating behaviors (Pliner & Chaiken, 1990), but appearing feminine is important for some females, while being distinct is imperative for some males (Salvy, et al., 2007). Research found that both males and females consumed less food when eating with strangers of the opposite sex (Mori, et al., 1987). Females consumed less ice cream when a desirable male was present (Mori, et al., 1987), but more often conformed to their eating companions' consumption than males (Salvy, et al., 2007). Women who ate less were viewed more positively than women who consumed larger quantities (Chaiken & Pliner, 1987).

Additionally, people who are overweight may adjust their eating behavior in front of others to avoid being stereotyped as lazy or lacking self control (Brownell, Puhl, Schwartz, & Rudd, 2005; DeJong & Kleck, 1986; Puhl, Schwartz, & Brownell, 2005). Self-presentation, conformity, dining group size, social familiarity, and gender likely operate together within the social environment to affect eating behaviors.

Current study. Americans consume approximately two-thirds of their total daily calories from meals prepared at home (Guthrie, Lin, & Frazao, 2002; Wells & Rollings, under review), yet few studies have examined how changing residential kitchenscapes may have influenced food and beverage salience and eating behaviors of individuals. The current study investigated the effects of food and beverage salience[8] in open[9] and closed kitchen floor plans on participants' eating behaviors when dining with strangers or friends. The primary objective was to examine influences of both the built and social environments on individual eating behaviors within a primary microsetting, the home. Within the context of the ecological model, research on the effects of microsettings and dietary intake is lacking. This study explored how kitchen floor plan design (built environment factor) and social familiarity among eating companions (social environment factor) affected three eating behaviors during

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[8] Participants navigated around a screen in the closed condition, simulating the behavior required to walk to a door or fixed point of entry into a closed kitchen.

[9] In this study, an open kitchen was defined as a kitchen (cabinetry and appliances) enclosed by less than three full-height walls, and that shared space with a dining area such that no wall or doorway existed between the dining and kitchen areas. While there are multiple dimensions to consider when classifying kitchen openness, the current study focused on wall enclosure and salience of the kitchen from the dining area.

a buffet-style meal: food and beverage serving trips, amount of food and beverage served,[10] and amount of food and beverage consumed. Analyses also explored interactions between microsystem variables such as floor plan openness, social familiarity, housing type, social interaction, and dining group size, and individual level variables such as education level, gender, hunger, ethnicity, income,[11] age, and body mass index (BMI). Participants were expected to make more serving trips, serve more, and consume more in the open condition because of the increased salience of food and beverage when compared to the closed condition. Friends dining together were also expected to make more serving trips, serve more, and consume more than strangers dining together. The effects of kitchen floor plan openness and social familiarity on college students' eating behaviors were further expected to be moderated by gender, hunger, social interaction, BMI, and dining group size.

[10] Participants served themselves all food and beverage.
[11] Income level was recorded as a measure of socioeconomic status.

CHAPTER 2

METHODS

Research Design

This repeated measures, 2x2 factorial study used college student participants to explore the effects of kitchen floor plan openness and social familiarity on eating behaviors among dining groups in a semi-controlled test kitchen that simulated a residential eating environment.

Independent variables. The research design was a mixed model with *kitchen floor plan openness* as the within-subjects independent variable and *social familiarity* as the between-subjects independent variable. Kitchen floor plan openness had two levels (open and closed conditions) which were manipulated by the absence (open condition) or presence (closed condition) of folding screens in the test kitchen. Because the kitchen counter and appliances were located along one wall, folding screens were used as a wall-like partition to separate the kitchen from the eating area. This simulated a closed residential kitchen floor plan with no view of kitchen appliances, counters, or food. Social familiarity was operationalized by participant dining group composition: friends versus strangers.[12]

Dependent variables. The dependent variable, eating behavior, was measured in three ways during a buffet-style meal. First, the number of *serving trips* (number of times they went to obtain food in the kitchen) made by

[12] Neither the friend nor the stranger dining groups contained all close friends or all complete strangers. Participants in the friend condition were recruited from an undergraduate lecture class. There were no strangers in these dining group sessions, but 50% indicated that they recognized a classmate, 24% recognized a friend, and 26% recognized both a classmate and friend.

each participant was recorded, as well as what type of food or beverage was served, each time a person moved from the table to obtain food or beverage. Second, the *amount of food and beverage served* (measured in both grams and calories) by each participant was recorded by either counting pre-weighed salad dressing, dessert,[13] and beverage containers, or by recording scale readings as participants served themselves pasta and salad. Third, the *amount of food and beverage consumed* (measured in both grams and calories) by each participant was calculated by weighing all food and beverage waste remaining at the end of a dining session and subtracting it from the amount served.

Research questions. The research questions for this study were generated based on anticipated influences of two built and social environment factors, kitchen floor plan openness and social familiarity, respectively, on eating behaviors, as well as how these effects may be moderated by personal and demographic factors.

1. Do participants make more serving trips for, serve more, and consume more food and beverage in an open versus closed residential kitchen floor plan? The hypothesis was that participants would make more serving trips, serve more, and consume more in the simulated open condition because of the increased salience of food and beverage when compared to the closed condition.

2. Do participants dining with friends make more serving trips for, serve more, and consume more food and beverage than participants dining with

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[13] Desserts offered to stranger dining groups differed slightly ("cookies and crème" snack size candy bars v. plain milk chocolate pieces) from those offered to friend dining groups due to availability.

strangers? Because previous research indicated that friends dining together were less affected by conformity and self-presentation than strangers (Clendenen, et al., 1994; Salvy, et al., 2007), dining group friends were expected to make more serving trips, serve more, and consume more than dining group strangers.

3. Is there an interaction between kitchen floor plan openness and social familiarity on eating behaviors? Friends were expected to consume more than strangers, especially in the open condition, because of the increased salience of food and beverage, and the reduced influence of conformity and self-presentation.

4. Do the effects of kitchen floor plan openness and social familiarity on eating behaviors vary by education level, gender, hunger, social interaction, ethnicity, income,[14] housing type, age, body mass index (BMI), or dining group size? While studies have found that eating behaviors were moderated by all of the factors listed above, the non-representative study sample of college students was expected to only experience differences in eating behaviors based on gender, hunger, social interaction, BMI, and dining group size. Males, hungrier participants, participants in more socially interactive dining groups, participants with higher BMI, and participants in larger dining groups were expected to make more serving trips, serve more, and consume more food and beverage than females, less hungry participants, participants with less socially interactive dining groups, participants with lower BMI, and participants with smaller dining group sizes.

[14] Income level was recorded as a measure of socioeconomic status.

Setting

This study was conducted in the Cornell Food and Brand Lab's test kitchen on weeknights during November and December, 2009. The kitchen counter and appliances were located along one wall (see diagram, Appendix G). Two windows, residential dining furniture and kitchen appliances, wood trim and cabinets, and painted walls created the appearance of a homey, residential kitchen and dining area (Illustrations 1-4). The door into the test kitchen was closed during dining sessions. Two two-way mirrors allowed for unobtrusive observation of participants during dining group sessions.

Illustration 1. Dining table and television setup in the test kitchen.

Illustration 2. Digital scale displays were hidden in the kitchen sink.

Illustration 3. One of two two-way observation mirrors in the test kitchen.

Illustration 4. Folding screens during set-up for a closed floor plan dining session.

Participants

Sixty-nine Cornell undergraduate and graduate students were recruited via flyers posted on campus, online campus study recruitment websites through the Psychology and Applied Economics and Management (AEM) departments, and word of mouth. Participants' demographic information is displayed in Table 2.

Table 2. Participant Demographic Variables

Variable	Levels	TOTAL *(n=57)*		Friends *(n=21)*		Strangers *(n=36)*		Mean Dif. ***(SE)*** *t*-test results^
		%	#	%	#	%	#	
Education level	Undergraduate student	82.5	47	100	21	72.2	26	0.28 *(0.07)*
	Graduate student	17.5	10	0	0	27.8	10	**$t_{(112)}$ = 3.98, *p*=.000*** **
Gender	Male	38.6	22	47.6	10	33.3	12	$t_{(112)}$ = 1.51, *p*=.133
	Female	61.4	35	52.4	11	66.7	24	
Income	< $ 20,000	12.3	7	0	0	19.4	7	
	$ 20,000 - $ 40,000	8.8	5	0	0	13.9	5	
	$ 40,001 - $ 80,000	19.3	11	14.3	3	22.2	8	-1.21 *(0.25)*
	$ 80,001 - $120,000	22.8	13	33.3	7	16.7	6	**$t_{(108)}$ = -4.86, *p*=.000*** **
	> $120,000	33.3	19	47.6	10	25.0	9	
	Did not report	3.5	2	4.8	1	2.8	1	
Ethnicity	African American	7.0	4	4.8	1	8.3	3	
	Asian	40.4	23	47.6	10	36.1	13	$t_{(112)}$ = -0.14, *p*=.889
	Caucasian	49.1	28	47.6	10	50.0	18	
	Hispanic/Latino	3.5	2	0	0	5.6	2	
Housing Type	Apartment	57.9	33	61.9	13	55.6	20	
	House	17.5	10	28.6	6	11.1	4	$t_{(112)}$ = 1.85, *p*=.067
	Dormitory	24.6	14	9.5	2	33.3	12	
BMI[15]	Mean	22.6		23.3		22.3		
	SD	3.2		3.3		3.1		$t_{(110)}$ = -1.63, *p*=.110
	Range	18.4 – 32.5		18.6 – 32.3		18.4 – 32.5		
Age *(years)*	Mean	21.3		20.7		21.6		0.05 *(0.88)*
	SD	2.3		0.8		2.8		**$t_{(112)}$ = 2.03, *p*=.045***
	Range	18 - 28		20 - 23		18 - 28		

Estimates and standard errors are reported for significant results only
^ *Comparisons between participant demographics in the friend and stranger conditions*
* *Indicates a statistically significant (p<0.05) estimate of the mean*
*** *Indicates a statistically significant (p<0.001) estimate of the mean*

[15] BMI = [Weight (pounds) / Height^2 (inches)] x 703 or Weight (kilograms) / Height^2 (meters)

Twelve students were excluded[16] from the study because they did not attend both open (nine dropouts) and closed (three dropouts) kitchen floor plan conditions, generating a final sample of 57 students.[17] Significant differences between participant demographics in the friend and stranger conditions were only found for education level, income, and age. Students were compensated with two free dinners as part of the study, but could also obtain extra credit in classes offering this incentive. AEM undergraduate students could also choose to receive $15 instead of extra credit.

During recruitment, participants were told that the study was about group behavior and that the two free dinners served as compensation. Participants individually and unknowingly volunteered for the "stranger" condition, but groups of classmates/friends were recruited together for the "friend" condition. Dining group size ranged from three to seven people for the stranger condition, and five to seven people for the friend condition.[18] Participant strangers and participant friend dining groups were randomly assigned to one of two experimental condition orders (open-closed and closed-open).[19] Thirty-six students participated in the "strangers" open and closed conditions and 21 students attended the "friends" open and closed conditions. After completing both sessions, participants were told that the

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[16] Analyses indicated no significant differences between the 12 excluded participants and the 57 participants who attended both sessions.

[17] A sample size estimation of 16 was calculated utilizing G*Power 3.1.2 software with the following input parameters for *F-tests*: Statistical test=ANOVA: Repeated measures, within-between interaction; *type of power analysis*= A priori: Compute required sample size – given alpha, power, and effect size; *effect size*=0.5; *alpha*=0.05; *number of groups*=2; *number of measurements*=2; *correlation among repeated measures*=0.5; *nonsphericity correction*=1 (default) (Sodigov, S., Cornell Statistical Consulting Unit Consultant, personal communication, September, 2009).

[18] Average open and closed condition dining group sizes were 6.14 and 5.92, respectively.

[19] Friend dining group sessions were conducted by an undergraduate research group as part of an AEM class.

study actually examined whether or not the presence of the folding screens (open vs. closed floor plan), friends, and strangers affected their eating behaviors. Post-experiment discussions with participants revealed that they were naïve to the study's true purpose. No one was aware that food and beverage servings were being weighed and recorded during the study, or that the "assistant" in the kitchen throughout the study was responsible for anything other than preparing the meal and controlling the video playing during the meal.

Procedures

Preparation. While preheating pasta in the oven, a dining table with eight chairs was set with a table cloth, disposable plates, bowls, napkins, and forks. Consent forms (Appendix C), questionnaires (Appendix D), and name tags were placed below each plate. Name tags were pre-numbered with a seat number to assist researchers with coding observations. Regardless of how many participants were expected to attend a particular dining session, all eight places were set. This allowed participants to choose their own seat.

Next, 16 servings of salad dressing (eight Italian and eight ranch),[20] were pre-weighed using a food scale (Battery-operated scale, 5 lb/2.2 kg capacity; Pelouze: Norwalk, CT) and separated into plastic cups. Then, two food weighing scales (CPWplus 15 bench scale, 33lb/15kg capacity; AE Adam: Danbury, CT) were surrounded by books of similar height and all covered with a table cloth. This made the food appear to be resting on the

[20] Salad and dressing were complementary items, which are items often jointly consumed and may frequently vary together (e.g., peanut butter and jelly, milk and cereal, etc.). The two salad dressings were also substitutes, meaning either or both could be chosen. Regular soda, diet soda, and water were also substitutes.

counter top. Digital scale displays were also hidden by placing them in the sink behind a drying rack of dishes. Serving bowls of mozzarella cheese (1/2 bag), dessert candy (21 pieces), soda (8 cans of diet cola, 8 cans of regular cola), water (8 bottles), and the salad dressing were arranged on the counter top (refer to Appendix A for a complete supply list). Then, a salad bowl (containing one-and-a-half 16-ounce bags of salad) and the covered full pasta tray were each placed on one of the two hidden scales just before participants entered. The platescapes, tablescapes, and characteristics of the kitchenscape, except for the screen present in the closed condition, remained the same for all sessions (e.g., food and beverage serving vessels, utensils, and layout; dining table setting; room lighting, temperature, and smell).

During the closed floor plan condition sessions, two folding screens were placed between the dining table and kitchen counter before participants arrived; a door-sized opening remained to allow access to the food. No participant could view food, countertops, or kitchen appliances unless they went behind the screen. This decreased salience of the food and external cues related to eating present in the kitchen. It also decreased the perceived convenience of kitchen access by hiding these cues, and presented a wall-like “barrier” between the participants and food.

Data collection. All participants remained in the hallway outside of the test kitchen, before entering as a group, to control for the amount of time spent in the kitchen and viewing and smelling the food before dining. They chose a seat and wrote their first names on the pre-numbered name tags. This facilitated conversation and followed their expectations about a group behavior study. Once consent forms were completed, participants were directed by a researcher to enjoy an unlimited amount of pasta, salad, dessert, and beverages, already prepared and waiting for them on the kitchen counter. The researcher had memorized a script (Appendix B), and exited the room after reciting the instructions.

Dinner was served buffet-style while participants watched clips from a popular comedy show for 24 minutes.[21] Because nearly 64% of American families watch television during meal times (Feldman, Eisenberg, Neumark-Sztainer, & Story, 2007; Kaiser Family Foundation, 2005), a video was shown to further simulate dining in a residential setting. The popular comedy series also promoted social interaction, especially among strangers dining together, to further simulate dining with family, friends, or roommates in a residential setting. One researcher, dressed as a chef, remained in the test kitchen during dining sessions to control the video and record the amount of pasta and salad served. Part of the researcher's script had also requested that participants serve themselves one at a time due to limited space, which allowed the "chef" to discretely record the weights of pasta and salad served by participants after they returned to their seats. Output was recorded on the negative reading form (Appendix E) from each of the two digital scale displays hidden in the kitchen sink. Displays indicated how much food had been removed (served) from the pasta tray and salad bowl, each resting on their own scale (B. Wansink,[22] personal communication, November, 2009). The numbers displayed were the negative readings.[23] The weights recorded on the negative reading form were

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[21] Although distractions such as watching television have been found to increase food consumption (Wansink, 2004), two similar videos of the same length were viewed during all study sessions.

[22] Cornell University Professor and Director of the Cornell Food and Brand Lab.

[23] For example, before participants served pasta or salad, digital scale displays read "zero." If the first person served 200 grams of pasta and 20 grams of salad, the digital scale displays read "-200" and "-20." The chef recorded the participant's seat number, then "-200" and "-20" on the negative reading form. If the next participant served 300 grams of pasta and 30 grams

used to calculate the amount of salad and pasta participants served themselves in grams (and later converted into calories). One (or, in some cases, two) additional researchers observed participants through two-way mirrors and recorded, on observation forms (Appendix F), the number of serving trips made by each participant, as well as the quantity of premeasured items and the types of food and beverage served each trip.

The order of study conditions and comedy videos were counterbalanced. After the video ended, participants completed a brief questionnaire (Appendix D) that contained nine personal and demographic questions (gender, income, education level, ethnicity, age, height, weight, housing type, and language), two hunger questions, and one food satisfaction question, in addition to four questions about the video and group session to not yet reveal the study's true purpose. Upon completion of the video and questionnaire, participants were told to leave food and beverage waste behind for staff so participants could leave on time. Food and beverage waste was then weighed and recorded on a waste form (Appendix G), later used to calculate the amount of food and beverage consumed by each participant. Depending on the type and location of food or beverage waste, the weight of an empty plate, bowl, salad dressing cup, soda can, or water bottle was subtracted from the recorded waste weight; the resulting number was then subtracted from the amount served to calculate amount consumed.

Data analysis - Research questions 1-3: Using the Statistical Package for the Social Sciences (SPSS, Version 17), serving trips for individual food and beverage items, total food serving trips, total beverage serving trips, and

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of salad, displays read "-500" and "-50," respectively, and were recorded. Because scale display readings indicated food *removed*, output was referred to as a *negative reading*.

total food and beverage serving trips[24] were each first subjected to a linear mixed model (LMM) procedure, similar to a repeated measures 2x2 analysis of variance (ANOVA) with two levels of floor plan openness (open, closed) and two levels of social familiarity (stranger, friend). The LMM procedure was also conducted for individual food and beverage items, total food, total beverage, and total food and beverage both served and consumed. Post hoc pairwise comparisons, using Bonferroni adjusted alpha values of 0.0125 (0.05/4),[25] were performed when interactions between floor plan openness and social familiarity were significant at the 0.05 level. Insignificant (p>0.05) interactions between floor plan openness and social familiarity, however, were removed from analyses in SPSS (requiring use of a LMM procedure) to recalculate main effects of floor plan openness and social familiarity. SPSS repeated measures ANOVA procedures did not allow insignificant interaction terms to be removed from analyses; thus, there was an increased chance of incurring a Type II statistical error and incorrectly concluding that no significant main effects were found (F. Vermeylen,[26] personal communication, July, 2010). Therefore, a LMM procedure was utilized for all analyses.

Data analysis - Research question 4: A LMM procedure was also employed to explore whether the effects of floor plan openness and social familiarity varied by personal and demographic variables. LMMs are appropriate for these data because they address observations that are

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[24] Average amount served per average serving trip and average amount consumed per average serving were also analyzed, but did not yield additional significant results. Future research could further explore amount served per trip and amount consumed per trip.
[25] Bonferroni corrections, although conservative, were utilized to reduce the chance of incurring a Type I error when conducting multiple comparisons.
[26] Director and Statistical Consultant, Cornell Statistical Consulting Unit, Cornell University.

correlated and not independent, such as repeated measures.[27] The required assumption of independence between repeated observations for a general linear model (GLM) is violated, increasing the risk of a Type I error (Gibbons & Hedeker, 1994). Correlated observations generated by repeated measures require analysis that accounts for both within- and between-subject variability (F. Vermeylen,[26] personal communication, July, 2010). GLMs (e.g., analysis of covariance) can handle correlated observations,[28] but often problematically; therefore, LMMs are preferred (Gibbons & Hedeker, 1994; Koh & Sadigov, 2010; Wolfinger & Chang, 1995).

The LMM procedure, a random-effects model, accounts for correlated observations and increased Type I error risk (Gibbons & Hedeker, 1994) by correctly modeling covariance from correlated repeated measures observations (Koh & Sadigov, 2010). Using a LMM procedure in SPSS, participant ID was entered as a random effect, all categorical variables as fixed effects (kitchen floor plan openness, social familiarity, education level, hunger, gender, social interaction, ethnicity, income, housing type, and order of experimental conditions), and all continuous variables (age, BMI, dining group size, and serving trips or amount served) as covariates. Number of serving trips was entered as a covariate when analyzing amount served, and amount served was entered as a covariate when analyzing amount consumed. These covariates were entered because people consume more from larger

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[27] Number of serving trips, amount served, and amount consumed were recorded for all participants in both open and closed conditions.

[28] GLMs in SPSS can handle repeated measures and random effects, but parameters are estimated assuming effects are fixed, and expected mean squares is utilized to calculate variance components. LMM procedures in SPSS, however, estimate parameters utilizing maximum likelihood estimation and provide more varied functionality (Littell, Henry, & Ammerman, 1998).

serving sizes (Wansink, 2004; Wansink & Cheney, 2005; Wansink, Painter, et al., 2005; Wells, et al., 2007), and presumably serve themselves more with an increased number of serving trips. Therefore, linear relationships were anticipated between number of trips and amount served, and between amount served and amount consumed.

Following backwards regression procedures, variables with a significance level greater than 0.10 were first removed from the model until only those with significance levels less than or equal to 0.05 remained. Two-way interactions were then entered into the model one at a time until a model containing only variables and interactions with significance levels less than or equal to 0.05 was generated. This procedure was repeated until regression models were obtained for number of food, beverage, and total food and beverage serving trips; amount of food, beverage, and total food and beverage served (in grams and calories); and amount of food, beverage, and total food and beverage consumed. Models for individual food and beverage items were not calculated as part of this study. All models were then run without any fixed effects in order to calculate the within- and between-subjects covariance explained by each model (Appendix H).

CHAPTER 3

RESULTS

Findings are organized based on the four research questions (Chapter 2) concerning the two main independent variables (IVs) of interest: kitchen floor plan openness and social familiarity. Main effects of, followed by interactions between, the two main IVs on eating behaviors (serving trips, amount served, amount consumed) are first reported. Then, models exploring how effects of the two main IVs varied by personal and demographic factors are presented for number of food, beverage, and total food and beverage serving trips; amount of food, beverage, and total food and beverage served (in both grams and calories); and amount of food, beverage, and total food and beverage consumed (in both grams and calories). Finally, a potential mediating relationship model is also presented. Unless otherwise noted, an alpha level of 0.05 was used for all statistical tests.

Kitchen Floor Plan Openness

Question 1: *Do people make more serving trips, serve more, and consume more food and beverage in an open versus closed residential kitchen floor plan?*

<u>*Serving trips*</u>. As expected, participants made significantly more *total food serving trips* (1.79 v. 1.56) and *total food and beverage serving trips* (2.89 v. 2.61) in the open condition (Figure 3).[29] However, serving trips for total

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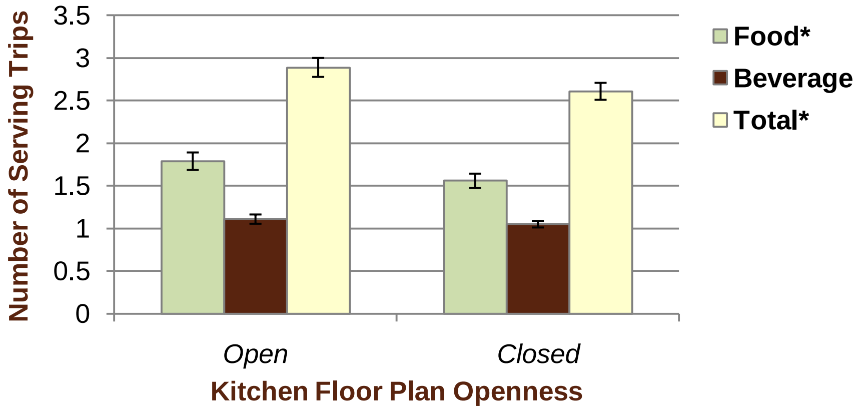
[29] Floor plan openness, the within-subjects independent variable, accounted for 7.36% (within-subjects) and 0% (between-subjects) of the total food serving trips covariance, and 7.74% (within-subjects) and 0% (between-subjects) of the total food and beverage serving trips covariance.

beverage, pasta, salad, salad dressing, dessert, soda (regular or diet), and water did not significantly differ between openness conditions (Table 3). Compared to closed kitchens, open kitchens were associated with significantly more food serving trips and total serving trips by participants.



Note: Error bars indicate standard error of the mean
** Indicates a statistically significant (p<0.05) difference between levels*

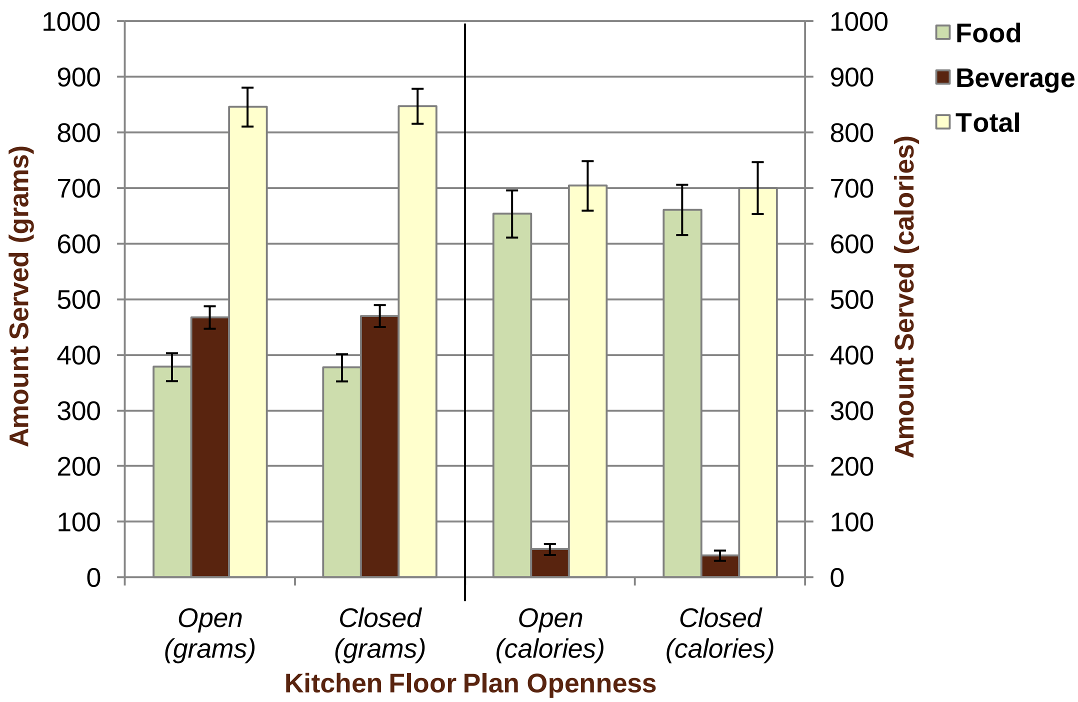
Figure 3. Number of Serving Trips Made in Open and Closed Kitchen Floor Plans

Table 3. Number of Serving Trips Made in Open and Closed Kitchen Floor Plans

	Kitchen Floor Plan Openness				**Main Effects** *(mixed model with openness, social familiarity and no interaction term)*		
	Open *(n=57)*		**Closed** *(n=57)^*				
Serving Trips	***Mean #***	***SD #***	***Mean #***	***SD #***	***Est.***	***SE***	***t-test results***
Pasta	1.53	0.60	1.49	0.66			$t_{(56)}$= 0.38, p=.709
Salad	1.12	0.68	1.07	0.62			$t_{(56)}$= 0.83, p=.410
Dressing	0.81	0.64	0.88	0.60			$t_{(56)}$= -1.07, p=.289
Dessert	0.82	0.57	0.82	0.63			$t_{(56)}$= 0.00, p=1.00
Soda-Regular	0.32	0.47	0.25	0.43	*(See Table 9)*		
Soda-Diet	0.19	0.44	0.18	0.43			$t_{(56)}$= 0.33, p=.742
Water	0.60	0.53	0.63	0.56			$t_{(56)}$= -0.44, p=.659
TOTAL Food	1.79	0.77	1.56	0.63	**0.23**	**0.10**	**$t_{(56)}$= 2.35, p=.022***
TOTAL Beverage	1.11	0.41	1.05	0.29	*(See Table 9)*		
TOTAL Trips	2.89	0.84	2.61	0.75	**0.28**	**0.12**	**$t_{(56)}$= 2.40, p=.020***

Estimates and standard errors are reported for significant results only
^ Indicates reference level
** Indicates a statistically significant (p<0.05) estimate of the mean*

Amount served (grams and calories). Kitchen floor plan openness did not significantly affect amount served, contrary to hypotheses. Figure 4 summarizes results for total food, total beverage, and total food and beverage served. Results were insignificant for amount of pasta, salad, salad dressing, dessert, soda (regular or diet), water, total food, total beverage, and total food and beverage served measured in both grams and calories (Table 4). This suggested that factors other than kitchen floor plan openness may have affected amount of food and beverage served.



Note: Error bars indicate standard error of the mean

Figure 4. Amount Served in Open and Closed Kitchen Floor Plans
(grams & calories)

Table 4. Amount Served in Open and Closed Kitchen Floor Plans *(grams and calories)*

	Kitchen Floor Plan Openness				Main Effects *(mixed model with openness, social familiarity and no interaction term)*	Kitchen Floor Plan Openness				Main Effects *(mixed model with openness, social familiarity and no interaction term)*
	Open *(n=57)*		**Closed** *(n=57)^*			**Open** *(n=57)*		**Closed** *(n=57)^*		
Amount Served	***Mean*** *grams*	***SD*** *grams*	***Mean*** *grams*	***SD*** *grams*	**t-test Results**	***Mean*** calories	***SD*** calories	***Mean*** calories	***SD*** calories	**t-test Results**
Pasta	290.28	160.96	289.81	158.76	$t_{(56)}$= 0.03, p=.980	546.41	302.98	545.52	298.85	$t_{(56)}$= 0.03, p=.980
Salad	56.67	43.10	53.30	35.53	$t_{(56)}$= 0.85, p=.402	10.00	7.61	9.41	6.27	$t_{(56)}$= 0.85, p=.402
Dressing	17.68	13.65	18.70	12.75	$t_{(56)}$= -0.75, p=.458	26.43	27.98	26.24	25.78	$t_{(56)}$= 0.06, p=.955
Dessert	13.80	12.22	15.52	14.25	$t_{(56)}$= -1.07, p=.288	71.11	63.82	80.12	74.58	$t_{(56)}$= -1.09, p=.280
Soda-Regular	117.79	174.92	91.61	161.99	*(See Table 10)*	50.53	75.03	39.30	69.48	*(See Table 11)*
Soda-Diet	69.28	158.22	62.98	153.56	$t_{(56)}$= 0.33, p=.742	n/a				
Water	280.70	267.55	315.79	277.61	$t_{(56)}$= -0.89, p=.376	n/a				
TOTAL Food	378.43	189.86	377.32	184.63	$t_{(56)}$= 0.05, p=.958	653.95	320.50	661.28	341.47	$t_{(56)}$= -0.19, p=.849
TOTAL Beverage	467.77	153.10	470.39	148.89	$t_{(56)}$= -0.10, p=.923	50.53	75.03	39.30	69.48	*(See Table 11)*
TOTAL Served	846.20	264.17	847.71	237.63	$t_{(56)}$= -0.04, p=.966	704.48	336.41	700.57	352.37	$t_{(56)}$= 0.10, p=.924

Estimates and standard errors are reported for significant results only
^ Indicates reference level

__Amount consumed (grams and calories)__. Hypotheses relating kitchen floor plan openness to amount consumed were also unsupported. Participants in the open condition did not consume significantly more food, beverage, or total food and beverage (Figure 5). Results were also insignificant for amount of pasta, salad, salad dressing, dessert, soda (regular or diet), water, total food, total beverage, and total food and beverage consumed (Table 5). Results indicated that factors other than floor plan openness affected the amount of food and beverage consumed by participants.

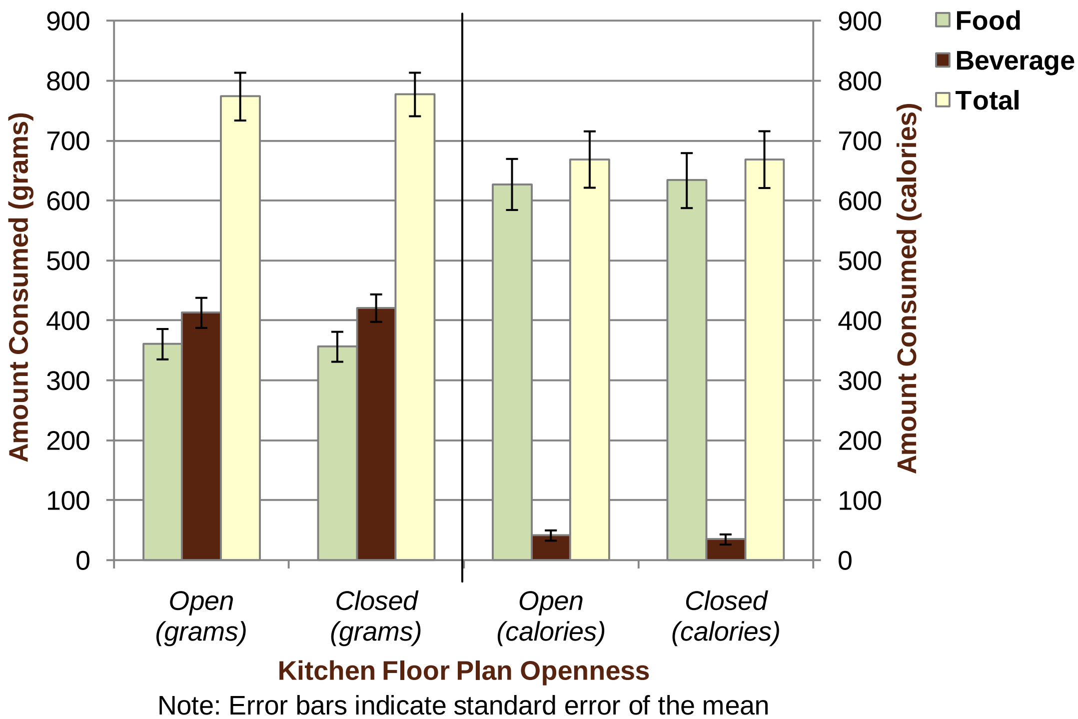


Figure 5. Amount Consumed in Open and Closed Kitchen Floor Plans
(grams & calories)

Table 5. Amount Consumed in Open and Closed Kitchen Floor Plans *(grams and calories)*

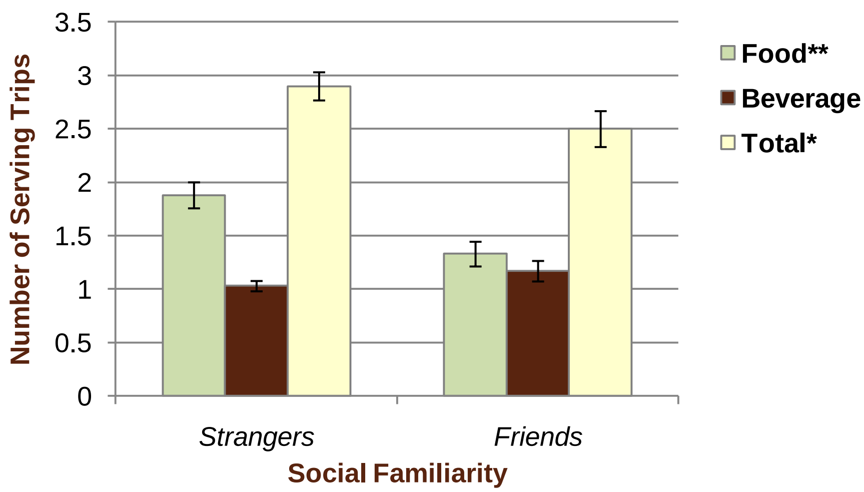
	Kitchen Floor Plan Openness				**Main Effects** *(mixed model with openness, social familiarity and no interaction term)*	**Kitchen Floor Plan Openness**				**Main Effects** *(mixed model with openness, social familiarity and no interaction term)*
	Open *(n=57)*		**Closed** *(n=57)^*			**Open** *(n=57)*		**Closed** *(n=57)^*		
Amount Consumed	***Mean*** *grams*	***SD*** *grams*	***Mean*** *grams*	***SD*** *grams*	***t-test Results***	***Mean*** *calories*	***SD*** *calories*	***Mean*** *calories*	***SD*** *calories*	***t-test Results***
Pasta	281.11	162.65	280.37	160.68	$t_{(56)}$= 0.04, p=.968	529.14	306.16	527.75	302.46	$t_{(56)}$= 0.04, p=.969
Salad	54.05	42.43	47.11	33.43	$t_{(56)}$= 1.78, p=.081	9.54	7.49	8.31	5.90	$t_{(56)}$= 1.78, p=.081
Dressing	12.00	10.49	13.72	10.35	$t_{(56)}$= -1.37, p=.177	18.07	21.45	18.58	19.26	$t_{(56)}$= -0.18, p=.859
Dessert	13.71	12.26	15.34	14.26	$t_{(56)}$= -1.04, p=.302	70.67	64.06	79.24	74.63	$t_{(56)}$= -1.06, p=.294
Soda-Regular	96.96	150.74	81.53	148.66	*(See Table 12)*	41.59	64.66	34.97	63.77	*(See Table 13)*
Soda-Diet	60.65	146.52	49.18	133.18	$t_{(56)}$= 0.69, p=.492	n/a				
Water	255.53	257.37	290.35	271.89	*(See Table 12)*	n/a				
TOTAL Food	360.87	191.34	356.53	188.81	$t_{(56)}$= 0.21, p=.832	627.42	321.83	633.89	346.37	$t_{(56)}$= -0.17, p=.862
TOTAL Beverage	413.14	189.43	421.05	173.12	$t_{(56)}$= -0.26, p=.795	41.59	64.66	34.97	63.77	*(See Table 13)*
TOTAL Consumed	774.01	300.92	777.58	274.08	$t_{(56)}$= -0.09, p=.926	669.02	335.10	668.86	357.79	$t_{(56)}$= 0.00, p=.997

Estimates and standard errors are reported for significant results only
^ Indicates reference level

Social Familiarity

Question 2: Do participants make more serving trips for, serve more, and consume more food and beverage when dining with friends v. strangers?

Serving trips. Figure 6 summarizes the main effects of social familiarity on total food, total beverage, and total food and beverage serving trips. Contrary to hypotheses, participants dining with strangers, not friends, made significantly more serving trips for *pasta* (1.69 v. 1.19), *salad* (1.29 v. 0.76), *dessert* (0.93 v. 0.64), *total food* (1.88 v. 1.33), and *total food and beverage* (2.90 v. 2.50) (Table 6).[30] Results for salad dressing, soda (regular or diet), water, and total beverage serving trips were not significant. With the exception of total beverage serving trips, findings indicated that self-presentation and conformity may have affected friends dining together more than strangers.



Note: Error bars indicate standard error of the mean
** Indicates a statistically significant (p<0.05) difference between levels*
***Indicates a statistically significant (p<0.01) difference between levels*

Figure 6. Number of Serving Trips Made in Stranger and Friend Dining Groups

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[30] Social familiarity accounted for 37.67% (pasta), 19.48% (salad), 11.79% (dessert), 29.60% (total food), and 13.66% (total food and beverage) of the between-subjects covariance for serving trips. Because social familiarity was the between-subjects IV, it did not account for any within-subjects covariance.

Table 6. Number of Serving Trips Made in Stranger and Friend Dining Groups

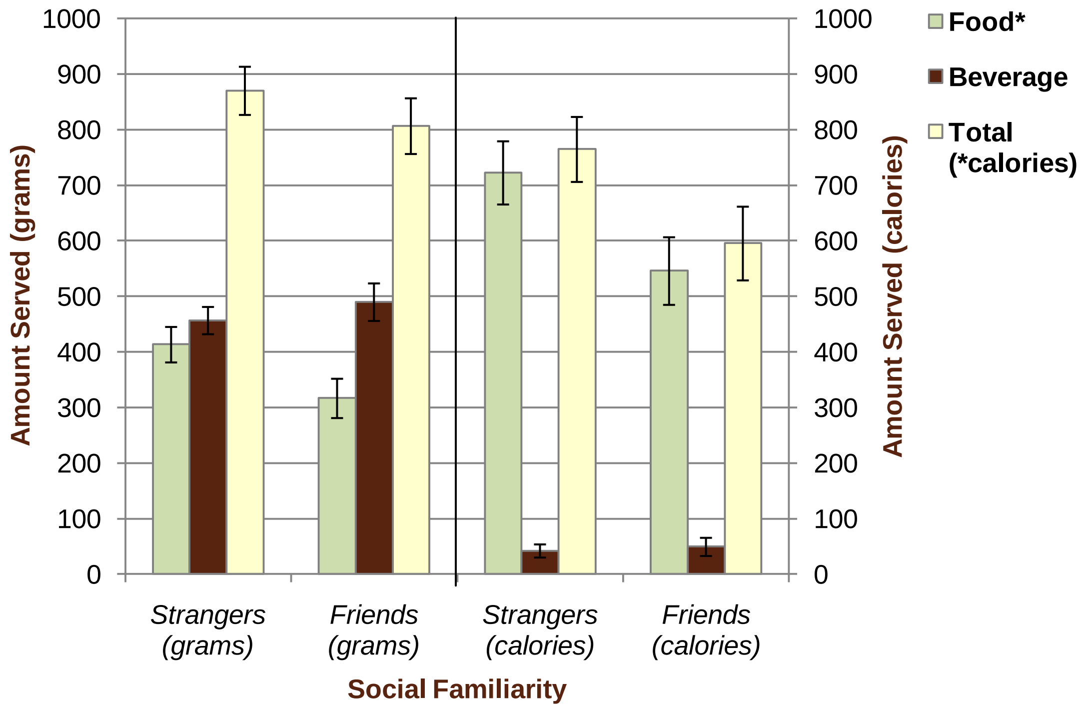
	Social Familiarity				Main Effects *(mixed model with openness, social familiarity and no interaction term)*		
	Strangers *(n=36)*		**Friends** *(n=21)^*				
Serving Trips	***Mean*** *#*	***SD*** *#*	***Mean*** *#*	***SD*** *#*	***Est.***	***SE***	***t-test results***
Pasta	1.69	0.64	1.19	0.46	**0.50**	**0.13**	$t_{(55)}$= **3.95**, p=**.000***
Salad	1.29	0.64	0.76	0.53	**0.53**	**0.15**	$t_{(55)}$= **3.47**, p=**.001**
Dressing	0.94	0.65	0.67	0.53			$t_{(55)}$= 1.82, p=.075
Dessert	0.93	0.59	0.64	0.58	**0.29**	**0.13**	$t_{(55)}$= **2.19**, p=**.033***
Soda-Regular	0.26	0.44	0.31	0.47	*(See Table 9)*		
Soda-Diet	0.17	0.41	0.21	0.47			$t_{(55)}$= -0.45, p=.657
Water	0.60	0.55	0.64	0.53			$t_{(55)}$= -0.36, p=.717
TOTAL Food	1.88	0.73	1.33	0.53	**0.54**	**0.15**	$t_{(55)}$= **3.62**, p=**.001**
TOTAL Beverage	1.03	0.29	1.17	0.44	*(See Table 9)*		
TOTAL Trips	2.90	0.79	2.50	0.77	**0.40**	**0.18**	$t_{(55)}$= **2.30**, p=**.025***

Estimates and standard errors are reported for significant results only
^ *Indicates reference level*
* *Indicates a statistically significant (p<0.05) estimate of the mean*
** *Indicates a statistically significant (p<0.01) estimate of the mean*
*** *Indicates a statistically significant (p<0.001) estimate of the mean*

Amount served (grams and calories). Figure 7 summarizes the main effects of social familiarity on total food, total beverage, and total food and beverage served. Contrary to expectations, strangers served significantly more *salad* (26.29 grams, 4.64 calories), *salad dressing* (13.67 calories only), *dessert* (9.29 grams, 51.86 calories), *total food* (96.69 grams, 176.68 calories), and *total food and beverage* (169.38 calories only) than friends (Table 7).[31] No

[31] Social familiarity accounted for 12.85%, 12.86% (salad grams, calories), 8.94% (salad dressing calories), 17.78%, 20.17% (dessert grams, calories), 7.56%, 8.67% (total food grams, calories), and 7.24% (total food and beverage calories) of the between-subjects covariance for amount served. Because social familiarity was the between-subjects IV, it did not account for any within-subjects covariance.

significant effects of social familiarity were found on pasta (grams and calories), salad dressing (grams only), regular soda (grams and calories), diet soda (grams only, contained no calories), water (grams only, contained no calories), total beverage (grams and calories), or total food and beverage (grams only) served. Results implied that friends may have been affected by self-presentation or conformity more than strangers, accounting for the overall smaller amount served among friends dining together.



Note: Error bars indicate standard error of the mean

** Indicates a statistically significant (p<0.05) difference between levels*

Figure 7. Amount Served in Stranger and Friend Dining Groups
(grams & calories)

Table 7. Amount Served in Stranger and Friend Dining Groups *(grams and calories)*

	Social Familiarity							Social Familiarity						
	Strangers *(n=36)*		**Friends^** *(n=21)*		**Main Effects** *(grams)* *(mixed model w/ openness, social familiarity and no interaction term)*			**Strangers** *(n=36)*		**Friends^** *(n=21)*		**Main Effects** *(calories)* *(mixed model w/ openness, social familiarity and no interaction term)*		
Amount Served	***Mean*** *grams*	***SD*** *grams*	***Mean*** *grams*	***SD*** *grams*	***Est.***	***SE***	***t-test Results***	***Mean*** *calories*	***SD*** *calories*	***Mean*** *calories*	***SD*** *calories*	***Est.***	***SE***	***t-test Results***
Pasta	310.89	164.76	254.31	143.98			$t_{(55)}$= 1.46, p=.151	585.20	310.14	478.70	271.02			$t_{(55)}$= 1.46, p=.151
Salad	64.67	38.71	38.38	35.04	26.29	9.48	$t_{(55)}$= 2.77, p=.008**	11.41	6.83	6.77	6.18	4.64	1.67	$t_{(55)}$= 2.77, p=.008**
Dressing	19.86	13.39	15.33	12.39			$t_{(55)}$= 1.37, p=.178	31.37	27.61	17.70	23.15	13.67	6.27	$t_{(55)}$= 2.18, p=.033*
Dessert	18.08	14.38	8.79	8.34	9.29	3.02	$t_{(55)}$= 3.07, p=.003**	94.72	75.31	42.86	40.68	51.86	15.69	$t_{(55)}$= 3.31, p=.002**
Soda-Regular	98.43	165.55	115.45	174.53	*(See Table 10)*			42.22	71.01	49.52	74.86	*(See Table 11)*		
Soda-Diet	59.83	147.59	76.93	168.87			$t_{(55)}$= -0.45, p=.657	n/a						
Water	298.61	273.99	297.62	271.84			$t_{(55)}$= 0.02, p=.988	n/a						
TOTAL Food	413.50	191.44	316.81	162.12	96.69	45.27	$t_{(55)}$= 2.14, p=.037*	722.71	341.20	546.03	278.93	176.68	79.03	$t_{(55)}$= 2.24, p=.029*
TOTAL Bev.	456.88	147.37	490.00	154.85			$t_{(55)}$= -1.09, p=.282	42.22	71.01	49.52	74.86	*(See Table 11)*		
TOTAL Served	870.38	260.03	806.81	229.66			$t_{(55)}$= 1.09, p=.279	764.93	350.92	595.55	303.93	169.38	82.29	$t_{(55)}$= 2.06, p=.044*

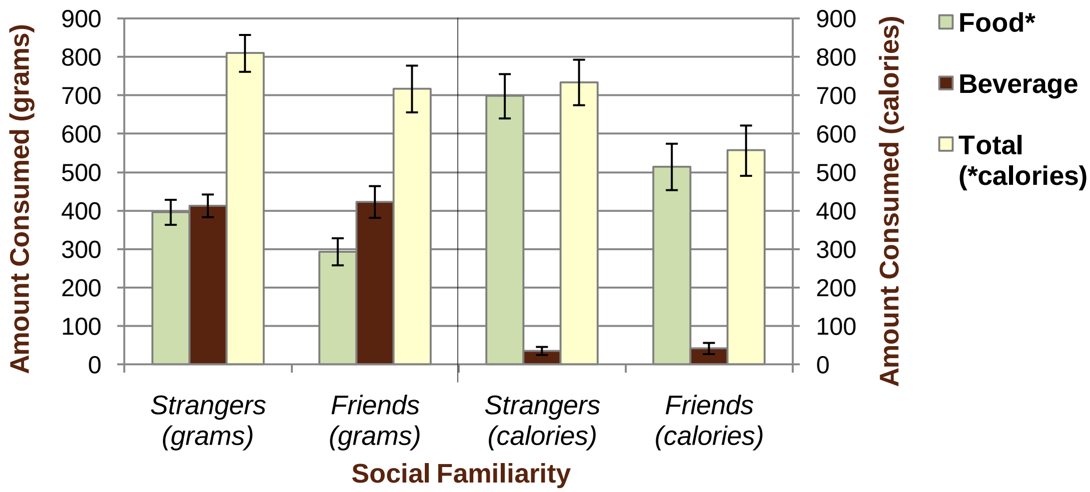
Estimates and standard error are reported for significant results only

^ *Indicates reference level*

* *Indicates a statistically significant ($p<0.05$) estimate of the mean*

** *Indicates a statistically significant ($p<0.01$) estimate of the mean*

<u>*Amount consumed (grams and calories)*</u>. Figure 8 summarizes the main effects of social familiarity on total food, total beverage, and total food and beverage consumed. Strangers dining together consumed significantly more *salad* (26.71 grams, 4.71 calories), *salad dressing* (4.98 grams, 9.89 calories), *dessert* (9.66 grams, 53.65 calories), *total food* (102.72 grams, 183.77 calories), and *total food and beverage* (177.46 calories only) than friends dining together, contrary to hypotheses (Table 8).[32] Results were not significant for pasta (grams and calories), regular soda (grams and calories), diet soda (grams only, contained no calories), water (grams only, contained no calories), total beverage (grams and calories), and total food and beverage (grams only) consumed. Findings indicated that friends may have been affected by conformity or self-presentation more than strangers.



Note: Error bars indicate standard error of the mean
** Indicates a statistically significant (p<0.05) difference between levels*

Figure 8. Amount Consumed in Stranger and Friend Dining Groups *(grams & calories)*

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[32] Social familiarity accounted for 14.72%, 14.72% (salad grams, calories), 7.01%, 9.70% (salad dressing grams, calories), 18.64%, 20.98% (dessert grams, calories), 8.13%, 8.88% (total food grams, calories), and 7.54% (total food and beverage calories) of the between-subjects covariance for amount consumed. Because social familiarity was the between-subjects IV, it did not account for any within-subjects covariance.

Table 8. Amount Consumed in Stranger and Friend Dining Groups (grams and calories)

	Social Familiarity							Social Familiarity						
	Strangers *(n=36)*		**Friends^** *(n=21)*		**Main Effects** *(grams)* *(mixed model w/ openness, social familiarity and no interaction term)*			**Strangers** *(n=36)*		**Friends^** *(n=21)*		**Main Effects** *(calories)* *(mixed model w/ openness, social familiarity and no interaction term)*		
Amount Consumed	***Mean*** *grams*	***SD*** *grams*	***Mean*** *grams*	***SD*** *grams*	***Est.***	***SE***	***t-test Results***	***Mean*** *calories*	***SD*** *calories*	***Mean*** *calories*	***SD*** *calories*	***Est.***	***SE***	***t-test Results***
Pasta	303.35	167.39	241.98	142.96			$t_{(55)}$= 1.55, p=.126	571.01	315.09	455.48	269.10			$t_{(55)}$= 1.55, p=.126
Salad	60.42	37.62	33.71	33.26	26.71	9.07	**$t_{(55)}$= 2.94, p=.005****	10.66	6.64	5.95	5.87	4.71	1.60	**$t_{(55)}$= 2.94, p=.005****
Dressing	14.69	10.50	9.71	9.58	4.98	2.48	**$t_{(55)}$= 2.01, p=.050***	21.97	20.86	12.08	17.85	9.89	4.61	**$t_{(55)}$= 2.14, p=.036***
Dessert	18.08	14.38	8.42	8.14	9.66	3.03	**$t_{(55)}$= 3.19, p=.002****	94.72	75.31	41.07	39.75	53.65	15.73	**$t_{(55)}$= 3.41, p=.001****
Soda-Regular	83.82	146.21	98.55	155.65	*(See Table 12)*			35.95	62.72	42.27	66.77	*(See Table 13)*		
Soda-Diet	51.18	132.94	61.31	151.56			$t_{(55)}$= -0.29, p=.771	n/a						
Water	278.39	268.21	263.82	259.96			$t_{(55)}$= 0.24, p=.812	n/a						
TOTAL Food	396.54	195.00	293.82	161.35	102.72	46.17	**$t_{(55)}$= 2.23, p=.030***	698.36	345.80	514.59	276.47	183.77	80.37	**$t_{(55)}$= 2.29, p=.026***
TOTAL Bev.	413.39	176.95	423.45	188.95			$t_{(55)}$= -0.26, p=.798	35.95	62.72	42.27	66.77	*(See Table 13)*		
TOTAL Consumed	809.93	287.55	717.28	278.48			$t_{(55)}$= 1.37, p=.177	734.32	354.81	556.86	299.75	177.46	83.56	**$t_{(55)}$= 2.12, p=.038***

Estimates and standard error are reported for significant results only
^ *Indicates reference level*
* *Indicates a statistically significant (p<0.05) estimate of the mean*
** *Indicates a statistically significant (p<0.01) estimate of the mean*

Interaction Between Kitchen Floor Plan Openness and Social Familiarity

Question 3: *Is there an interaction between kitchen floor plan openness and social familiarity on eating behaviors?*

Serving trips. Interactions between kitchen floor plan openness and social familiarity on food, beverage, and total food and beverage serving trips are summarized in Figures 9-11. A significant interaction between floor plan openness and social familiarity was found for *regular soda* and *total beverage serving trips* (Table 9). Effects of the open condition did not, however, amplify differences between strangers and friends as expected. Instead, post hoc pairwise comparisons, conducted with adjusted Bonferroni alpha levels of 0.0125 (0.05/4), indicated significant effects of floor plan openness on strangers' regular soda serving trips (0.36 open v. 0.17 closed regular soda serving trips, $p<0.0125$), of floor plan openness on friends' total beverage serving trips (1.29 open v. 1.05 closed total beverage serving trips, $p<0.0125$), and of social familiarity on total beverage serving trips in the open condition (1.00 stranger v. 1.29 friend total beverage serving trips, $p<0.0125$). Interaction effects on pasta, salad, salad dressing, dessert, diet soda, water, total food, and total food and beverage serving trips were insignificant. Although interaction effects on regular soda and total beverage serving trips were significant (Table 9), interaction effect sizes were modest.[33]

[33] Partial Eta squared values were 0.155 (regular soda) and 0.105 (total beverage), which meant that the interaction accounted for 15.5% and 10.5%, respectively, of the total variance for serving trips.

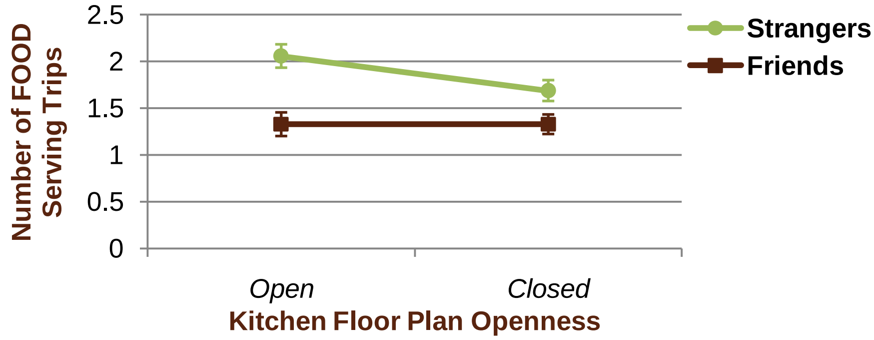
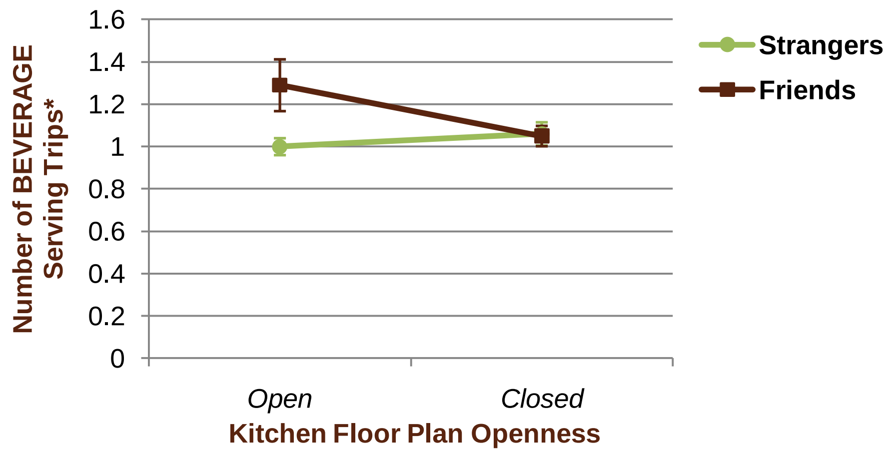


Figure 9. Interaction Between Kitchen Floor Plan Openness and Social Familiarity on FOOD Serving Trips



** Indicates statistically significant ($p<0.05$) difference between levels*

Figure 10. Interaction Between Kitchen Floor Plan Openness and Social Familiarity on BEVERAGE Serving Trips

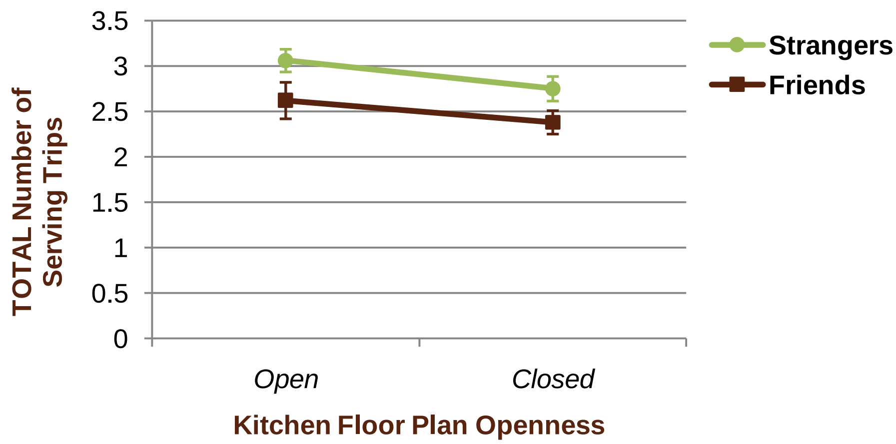


Figure 11. Interaction Between Kitchen Floor Plan Openness and Social Familiarity on TOTAL Serving Trips

Note: Error bars indicate standard error of the mean

Table 9. Interaction Between Floor Plan Openness and Social Familiarity on Serving Trips

Kitchen Floor Plan Openness	**Open** *(n=57)*				**Closed** *(n=57)*				**Interaction** *(mixed model w/ openness, social familiarity and interaction term)*		
Social Familiarity	**Strangers** *(n=36)*		**Friends** *(n=21)*		**Strangers** *(n=36)*		**Friends** *(n=21)*				
Serving Trips	***Mean #***	***SD #***	***Mean #***	***SD #***	***Mean #***	***SD #***	***Mean #***	***SD #***	***Est.***	***SE***	***t-test Results***
Pasta	1.75	0.60	1.14	0.36	1.64	0.68	1.24	0.54	*No significant results*		
Salad	1.36	0.64	0.71	0.56	1.22	0.64	0.81	0.51			
Dressing	0.92	0.65	0.62	0.59	0.97	0.65	0.71	0.46			
Dessert	0.92	0.55	0.67	0.58	0.94	0.63	0.62	0.59			
Soda-Regular	0.36^{Ac}	0.49	0.24^{bc}	0.44	0.17^{Ad}	0.38	0.38^{bd}	0.50	**0.33**	**0.11**	**$t_{(1,55)}$= 3.18, p=.002****
Soda-Diet	0.14	0.35	0.29	0.56	0.19	0.47	0.14	0.36	*No significant results*		
Water	0.50	0.51	0.76	0.54	0.69	0.58	0.52	0.51	*No significant results*[34]		
TOTAL Food	2.06	0.75	1.33	0.58	1.69	0.67	1.33	0.48	*No significant results*		
TOTAL Beverage	1.00^{aC}	0.24	1.29^{BC}	0.56	1.06^{ad}	0.33	1.05^{Bd}	0.22	**-0.29**	**0.12**	**$t_{(1,55)}$= -2.55, p=.014***
TOTAL Trips	3.06	0.75	2.62	0.92	2.75	0.81	2.38	0.59	*No significant results*		

* *Indicates a statistically significant (p<0.05) difference between levels*
** *Indicates a statistically significant (p<0.01) difference between levels*
*"**AA, BB**" etc. indicate significant pairwise comparisons conducted using Bonferroni adjusted alpha levels of 0.0125 (0.05/4)*
"aa, bb" etc. indicate insignificant pairwise comparisons conducted using Bonferroni adjusted alpha levels of 0.0125 (0.05/4)

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[34] This interaction was significant at the 0.05 alpha level, but removed from analyses because all pairwise comparisons were insignificant.

Amount served (grams). Figures 12-14 summarize the interactions between kitchen floor plan openness and social familiarity on amount of food, beverage, and total food and beverage served (grams). A significant interaction between floor plan openness and familiarity was found for amount of *regular soda* served (Table 10). Effects of the open condition did not amplify differences in amount served (grams) between those in the stranger and friend dining groups as anticipated. Post hoc pairwise comparisons, conducted with adjusted Bonferroni alpha levels of 0.0125 (0.05/4), indicated significant effects of floor plan openness on the amount of regular soda served by strangers (134.69 open v. 62.17 closed grams of regular soda served, $p<0.0125$). Although the interaction effect on regular soda served was significant (Table 10), the effect size was modest.[35] Interactions on pasta, salad, salad dressing, dessert, diet soda, water, total food, total beverage, and total food and beverage served (grams) were not significant.

[35] The partial Eta squared value was 0.155 (regular soda), which meant that the interaction accounted for 15.5% of the total variance for amount served (grams).

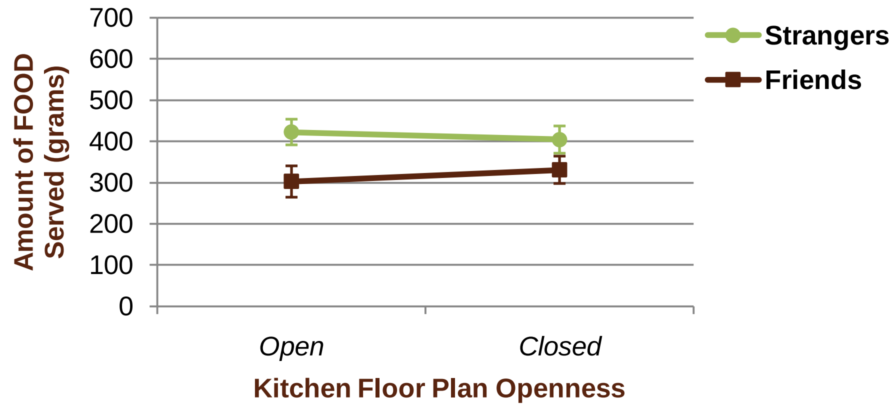


Figure 12. Interaction Between Kitchen Floor Plan Openness and Social Familiarity on Amount of FOOD Served *(grams)*

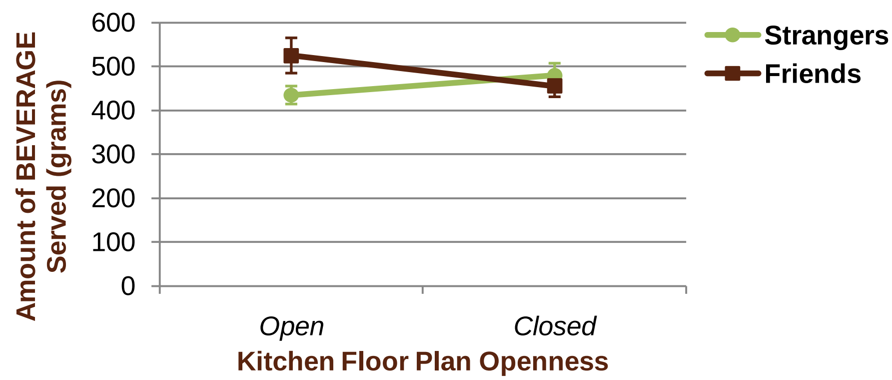


Figure 13. Interaction Between Kitchen Floor Plan Openness and Social Familiarity on Amount of BEVERAGE Served *(grams)*

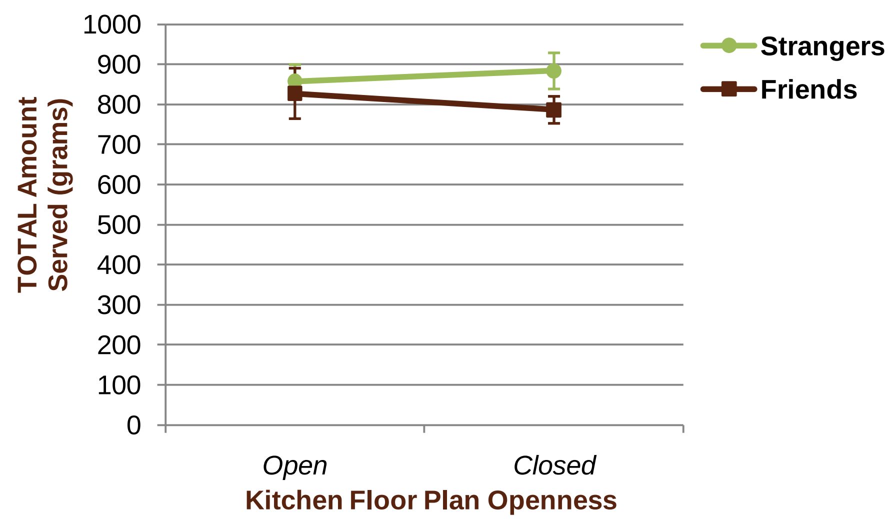


Figure 14. Interaction Between Kitchen Floor Plan Openness and Social Familiarity on TOTAL Amount Served *(grams)*

Note: Error bars indicate standard error of the mean

Table 10. Interaction Between Kitchen Floor Plan Openness and Social Familiarity on Amount Served *(grams)*

Kitchen Floor Plan Openness	Open *(n=57)*				Closed *(n=57)*				Interaction *(mixed model w/ openness, social familiarity and interaction term)*		
Social Familiarity	**Strangers** *(n=36)*		**Friends** *(n=21)*		**Strangers** *(n=36)*		**Friends** *(n=21)*				
Amount Served	***Mean*** *grams*	***SD*** *grams*	***Mean*** *grams*	***SD*** *grams*	***Mean*** *grams*	***SD*** *grams*	***Mean*** *grams*	***SD*** *grams*	***Est.***	***SE***	***t-test Results***
Pasta	316.94	165.62	244.57	145.14	304.83	166.03	264.05	145.72	*No significant results*		
Salad	68.83	40.70	35.81	39.76	60.50	36.71	40.95	30.38			
Dressing	20.17	14.28	13.43	11.61	19.56	12.64	17.24	13.12			
Dessert	16.72	13.31	8.79	8.13	19.44	15.44	8.79	8.75			
Soda-Regular	134.69^{Ac}	181.70	88.81^{bc}	162.79	62.17^{Ad}	140.98	142.10^{bd}	185.61	**125.81**	**39.57**	$t_{(1,55)}$= **3.18, *p*=.002****
Soda-Diet	49.86	125.91	102.57	201.26	69.81	167.72	51.29	128.73	*No significant results*		
Water	250.00^{ac}	253.55	333.33^{bc}	288.68	347.22^{ad}	288.33	261.90^{bd}	255.89	*No significant results*[36]		
TOTAL Food	422.67	186.86	302.60	174.17	404.33	198.23	331.02	152.04	*No significant results*		
TOTAL Beverage	434.56^{ac}	122.81	524.71^{bc}	183.97	479.19^{ad}	167.17	455.29^{bd}	113.07	*No significant results*[36]		
TOTAL Served	857.22	252.32	827.31	288.77	883.53	270.44	786.31	154.44	*No significant results*		

** *Indicates a statistically significant (p<0.01) difference between levels*
*"**AA**, **BB**" etc. indicate significant pairwise comparisons conducted using Bonferroni adjusted alpha levels of 0.0125 (0.05/4)*
"aa, bb" etc. indicate insignificant pairwise comparisons conducted using Bonferroni adjusted alpha levels of 0.0125 (0.05/4)

[36] This interaction was significant at the 0.05 alpha level, but removed from analyses because all pairwise comparisons were insignificant.

Amount served (calories). Contrary to expectations, effects of the open condition did not magnify differences in calories served between strangers and friends. Figures 15-17 summarize the interactions between kitchen floor plan openness and social familiarity on amount of food, beverage, and total food and beverage calories served. A significant interaction between floor plan openness and familiarity was only found on *regular soda* (*total beverage*)[37] calories served (Table 11), but the interaction effect size was modest.[38] Post hoc pairwise comparisons, conducted with adjusted Bonferroni alpha levels of 0.0125 (0.05/4), indicated significant effects of floor plan openness on the calories of regular soda (total beverage) served by strangers dining together (57.78 open v. 26.67 closed regular soda calories served, $p<0.0125$). Interaction effects on pasta, salad, salad dressing, dessert, total food, and total food and beverage served (calories) were also insignificant.

[37] Because regular soda was the only beverage that contained calories, regular soda and total beverage results for calories were always equivalent.
[38] Partial Eta squared values were 0.155 (regular soda=total beverage) which meant that the interaction accounted for 15.5% of the total variance for amount of calories served.

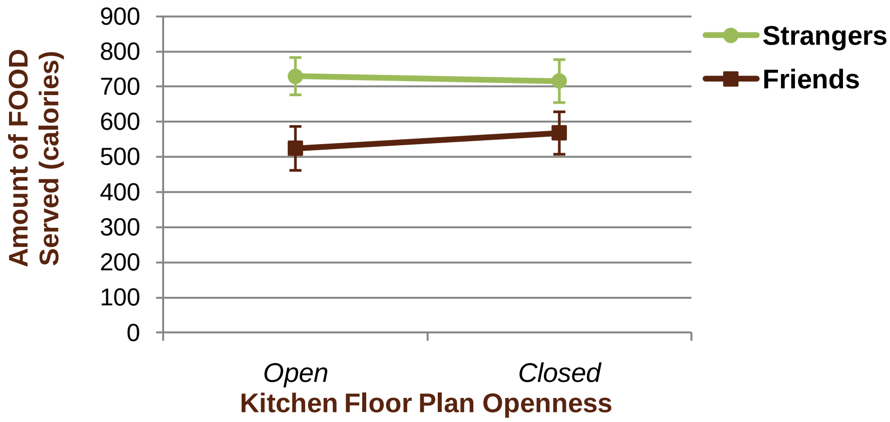
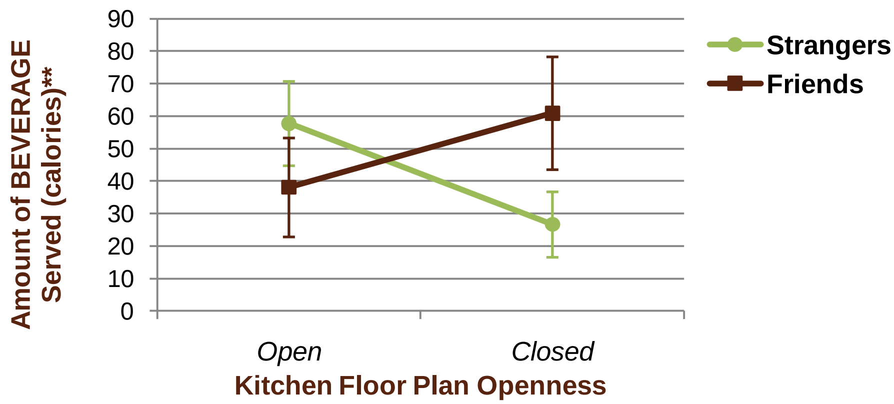


Figure 15. Interaction Between Kitchen Floor Plan Openness and Social Familiarity on Amount of FOOD Served *(calories)*



*** Indicates a statistically significant (p<0.01) difference between levels*

Figure 16. Interaction Between Kitchen Floor Plan Openness and Social Familiarity on Amount of BEVERAGE Served *(calories)*

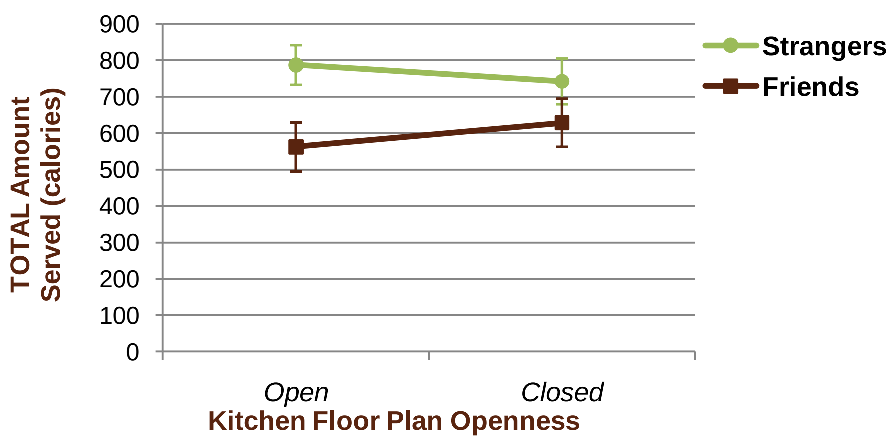


Figure 17. Interaction Between Kitchen Floor Plan Openness and Social Familiarity on TOTAL Amount Served *(calories)*

Note: Error bars indicate standard error of the mean

Table 11. Interaction Between Kitchen Floor Plan Openness and Social Familiarity on Amount Served (calories)

Kitchen Floor Plan Openness	**Open** *(n=57)*				**Closed** *(n=57)*				**Interaction** *(mixed model w/ openness, social familiarity and interaction term)*		
Social Familiarity	**Strangers** *(n=36)*		**Friends** *(n=21)*		**Strangers** *(n=36)*		**Friends** *(n=21)*				
Amount Served	***Mean*** *calories*	***SD*** *calories*	***Mean*** *calories*	***SD*** *calories*	***Mean*** *calories*	***SD*** *calories*	***Mean*** *calories*	***SD*** *calories*	***Est.***	***SE***	***t-test Results***
Pasta	596.60	311.75	460.37	273.20	573.80	312.52	497.03	274.29	*No significant results*		
Salad	12.15	7.18	6.32	7.02	10.68	6.48	7.23	5.36			
Dressing	33.33	30.14	14.60	19.24	29.41	25.10	20.79	26.62			
Dessert	87.59	69.72	42.86	39.64	101.85	80.86	42.86	42.68			
Soda-Regular	57.78^{Ac}	77.94	38.10^{bc}	69.83	26.67^{Ad}	60.47	60.95^{bd}	79.62	**53.97**	**16.97**	$t_{(1,55)}$= **3.18,** p=**.002****
Soda-Diet	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a		
Water	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a		
TOTAL Food	729.67	318.60	524.15	286.30	715.74	366.82	567.90	276.62	*No significant results*		
TOTAL Beverage	57.78^{Ac}	77.94	38.10^{bc}	69.83	26.67^{Ad}	60.47	60.95^{bd}	79.62	**53.97**	**16.97**	$t_{(1,55)}$= **3.18,** p=**.002****
TOTAL Served	787.45	327.85	562.24	308.45	742.41	375.86	628.86	303.13	*No significant results*		

** *Indicates a statistically significant (p<0.01) difference between levels*
*"**AA**, **BB**" etc. indicate significant pairwise comparisons conducted using Bonferroni adjusted alpha levels of 0.0125 (0.05/4)*
"aa, bb" etc. indicate insignificant pairwise comparisons conducted using Bonferroni adjusted alpha levels of 0.0125 (0.05/4)

Amount consumed (grams). Interactions between kitchen floor plan openness and social familiarity on grams of food, beverage, and total food and beverage consumed are summarized in Figures 18-20. Influences of the open condition did not amplify differences in amount consumed (grams) between strangers and friends as hypothesized. A significant interaction between floor plan openness and familiarity was only found for grams of *regular soda* consumed (Table 12), but the effect size was modest.[39] Post hoc pairwise comparisons, conducted with adjusted Bonferroni alpha levels of 0.0125 (0.05/4), indicated significant effects of floor plan openness on grams of regular soda strangers consumed (110.67 open v. 56.97 closed grams consumed, p<0.0125). Interaction effects on grams of pasta, salad, salad dressing, dessert, diet soda, water, total food, and total food and beverage consumed were not significant.

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[39] Partial Eta squared equaled 0.142 (regular soda) which meant that the interaction accounted for 14.2% of the total variance for amount consumed (grams).

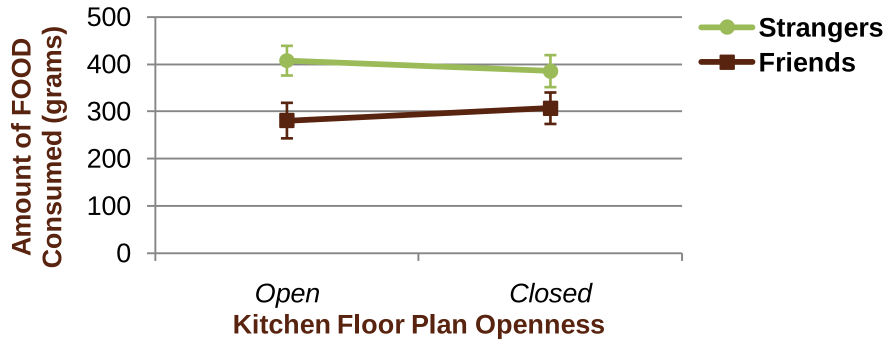


Figure 18. Interaction Between Kitchen Floor Plan Openness and Social Familiarity on Amount of FOOD Consumed *(grams)*

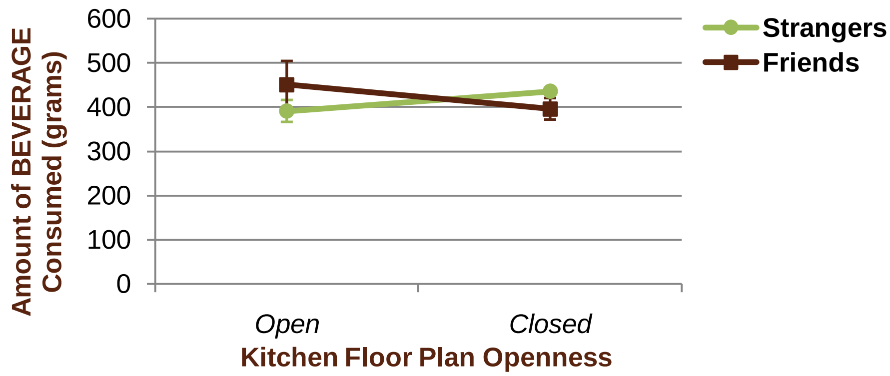


Figure 19. Interaction Between Kitchen Floor Plan Openness and Social Familiarity on Amount of BEVERAGE Consumed *(grams)*

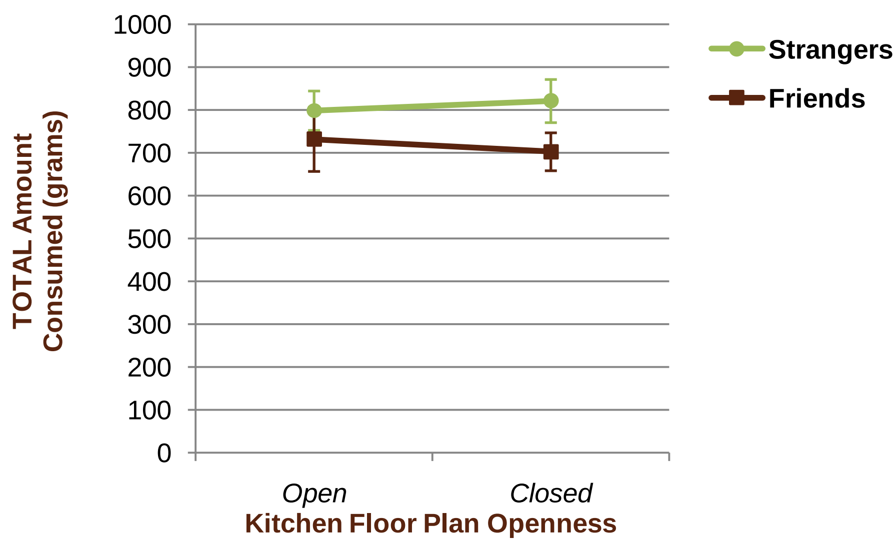


Figure 20. Interaction Between Kitchen Floor Plan Openness and Social Familiarity on TOTAL Amount Consumed *(grams)*

Note: Error bars indicate standard error of the mean

Table 12. Interaction Between Kitchen Floor Plan Openness and Social Familiarity on Amount Consumed *(grams)*

Kitchen Floor Plan Openness	**Open** *(n=57)*				**Closed** *(n=57)*				**Interaction** *(mixed model w/ openness, social familiarity and interaction term)*		
Social Familiarity	**Strangers** *(n=36)*		**Friends** *(n=21)*		**Strangers** *(n=36)*		**Friends** *(n=21)*				
Amount Consumed	***Mean*** *grams*	***SD*** *grams*	***Mean*** *grams*	***SD*** *grams*	***Mean*** *grams*	***SD*** *grams*	***Mean*** *grams*	***SD*** *grams*	***Est.***	***SE***	***t-test Results***
Pasta	310.31	166.27	231.05	146.72	296.39	170.57	252.90	141.84	*No significant results*		
Salad	65.97	40.76	33.62	37.94	54.86	33.86	33.81	28.78			
Dressing	14.61	10.58	7.52	8.89	14.78	10.57	11.90	9.94			
Dessert	16.72	13.31	8.54	8.16	19.44	15.44	8.30	8.34			
Soda-Regular	110.67[Ac]	156.42	73.48[bc]	141.03	56.97[Ad]	131.97	123.62[bd]	168.68	**103.84**	**34.36**	**$t_{(1,55)}$= 3.02, p=.004****
Soda-Diet	46.72	118.71	84.52	185.75	55.64	147.37	38.10	107.04	*No significant results*		
Water	233.67	243.51	293.00	281.72	323.11	287.25	234.19	239.48			
TOTAL Food	407.61	188.43	280.73	172.35	385.47	203.43	306.92	152.66			
TOTAL Beverage	391.06	149.07	451.00	243.31	435.72	20.67	395.90	111.32			
TOTAL Consumed	798.67	275.83	731.73	342.68	821.19	302.31	702.82	202.77			

*** Indicates a statistically significant (p<0.01) difference between levels*
*"**AA**, **BB**" etc. indicate significant pairwise comparisons conducted using Bonferroni adjusted alpha levels of 0.0125 (0.05/4)*
"aa, bb" etc. indicate insignificant pairwise comparisons conducted using Bonferroni adjusted alpha levels of 0.0125 (0.05/4)

Amount consumed (calories). Figures 21-23 summarize the interactions between kitchen floor plan openness and social familiarity on amount of food, beverage, and total food and beverage calories consumed. Contrary to expectations, the open condition did not magnify differences in calories consumed between participants dining with friends versus strangers. A significant interaction between floor plan openness and familiarity was only found for calories of *regular soda* (*total beverage*)[40] consumed (Table 13), but the interaction effect size was modest.[41] Post hoc pairwise comparisons, conducted with adjusted Bonferroni alpha levels of 0.0125 (0.05/4), indicated significant effects of floor plan openness on calories of regular soda (total beverage) consumed by strangers (47.47 open v. 24.44 closed regular soda calories consumed, $p<0.0125$). Interaction effects on calories of pasta, salad, salad dressing, dessert, total food, and total food and beverage consumed were insignificant.

[40] Because regular soda was the only beverage that contained calories, regular soda and total beverage results for calories were always equivalent.
[41] Partial Eta squared equaled 0.142 (regular soda=total beverage) which meant that the interaction accounted for 14.2% of the total variance for amount consumed (calories).

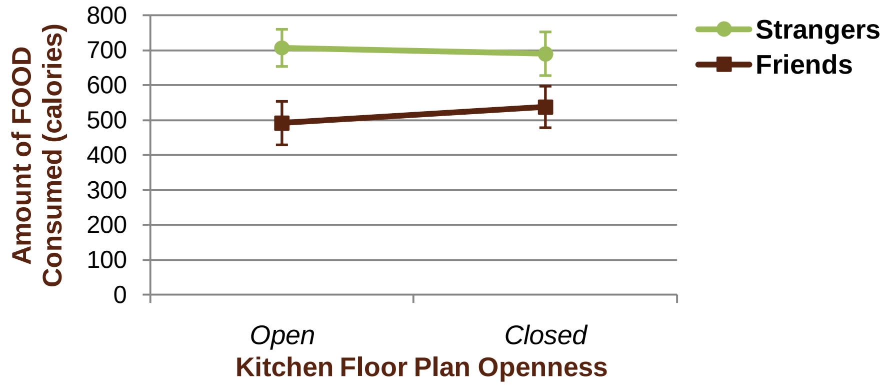
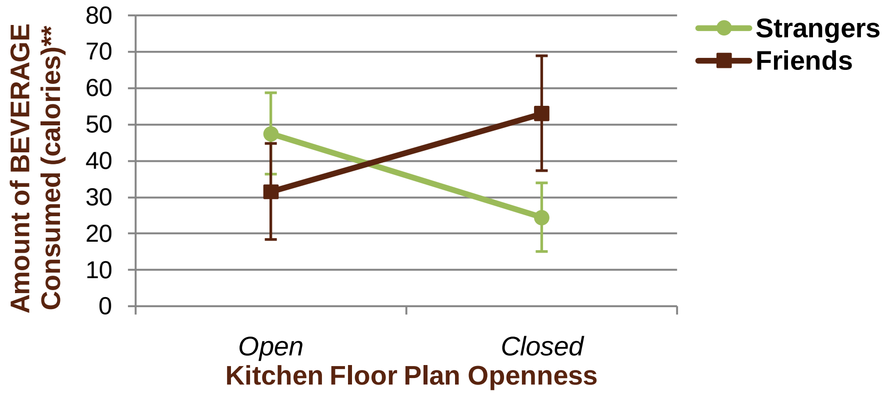


Figure 21. Interaction Between Kitchen Floor Plan Openness and Social Familiarity on Amount of FOOD Consumed *(calories)*



*** Indicates a statistically significant (p<0.01) difference between levels*

Figure 22. Interaction Between Kitchen Floor Plan Openness and Social Familiarity on Amount of BEVERAGE Consumed *(calories)*

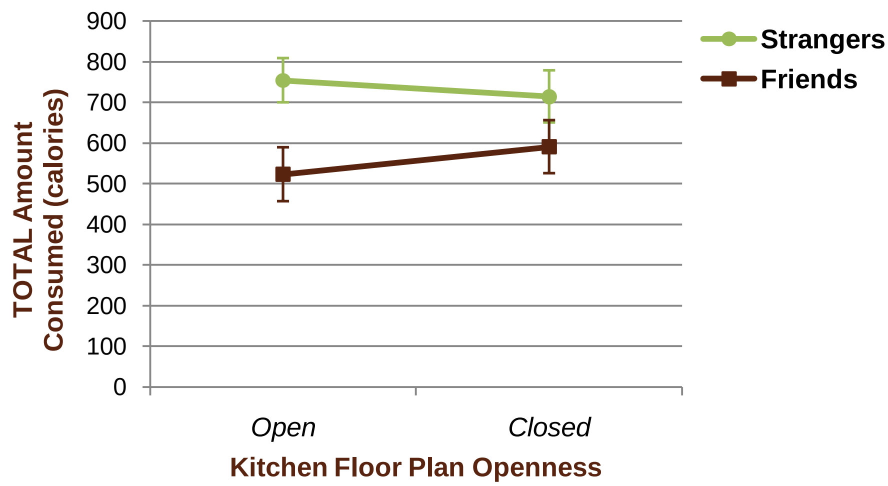


Figure 23. Interaction Between Kitchen Floor Plan Openness and Social Familiarity on TOTAL Amount Consumed *(calories)*

Note: Error bars indicate standard error of the mean

Table 13. Interaction Between Kitchen Floor Plan Openness and Social Familiarity on Amount Consumed *(calories)*

Kitchen Floor Plan Openness	**Open** *(n=57)*				**Closed** *(n=57)*				**Interaction** *(mixed model w/ openness, social familiarity and interaction term)*		
Social Familiarity	**Strangers** *(n=36)*		**Friends** *(n=21)*		**Strangers** *(n=36)*		**Friends** *(n=21)*				
Amount Consumed	***Mean*** *calories*	***SD*** *calories*	***Mean*** *calories*	***SD*** *calories*	***Mean*** *calories*	***SD*** *calories*	***Mean*** *calories*	***SD*** *calories*	***Est.***	***SE***	***t-test Results***
Pasta	584.10	312.97	434.91	276.17	557.91	321.08	476.06	267.00	*No significant results*		
Salad	11.64	7.19	5.93	6.70	9.68	5.97	5.97	5.08			
Dressing	23.10	22.91	8.94	15.20	20.54	18.81	15.23	20.03			
Dessert	87.59	69.72	41.67	39.79	101.85	80.86	40.48	40.68			
Soda-Regular	47.47^{Ac}	67.10	31.52^{bc}	60.50	24.44^{Ad}	56.61	53.03^{bd}	72.26	**44.54**	**14.74**	$t_{(1,55)}=$ **3.02**, p**=.004****
Soda-Diet	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a		
Water	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a		
TOTAL Food	706.74	318.88	491.45	285.17	689.98	375.15	537.73	272.49	*No significant results*		
TOTAL Beverage	47.47^{Ac}	67.10	31.52^{bc}	60.50	24.44^{Ad}	56.61	53.03^{bd}	72.36	**44.54**	**14.74**	$t_{(1,55)}=$ **3.02**, p**=.004****
TOTAL Consumed	754.22	326.52	522.97	303.96	714.42	384.65	590.75	298.98	*No significant results*		

*** Indicates a statistically significant (p<0.01) difference between levels*
*"**AA**, **BB**" etc. indicate significant pairwise comparisons conducted using Bonferroni adjusted alpha levels of 0.0125 (0.05/4)*
"aa, bb" etc. indicate insignificant pairwise comparisons conducted using Bonferroni adjusted alpha levels of 0.0125 (0.05/4)

How Effects of Kitchen Floor Plan Openness and Social Familiarity Vary by Personal and Demographic Variables

Question 4: *Do the effects of kitchen floor plan openness and social familiarity on eating behaviors vary by education level, gender, hunger, social interaction, ethnicity, income, housing type, age, BMI, or dining group size?*

Models were generated for nine dependent variables: number of serving trips for total food, total beverage, and total food and beverage combined; amount served (grams and calories) for total food, total beverage, and total food and beverage combined; and amount consumed (grams and calories) for total food, total beverage, and total food and beverage combined. Of the 16 IVs[42] initially entered into analysis (participant ID as a random effect; kitchen floor plan openness, social familiarity, education level, gender, hunger, social interaction, ethnicity, income, housing type, and order of experimental conditions as fixed factors; and age, BMI, dining group size, serving trips, and amount served[43] as covariates), five were omitted because they were not significant in any models: ethnicity, income, housing type, and order of experimental conditions.[44] Age was highly correlated with education level and was therefore also excluded from analysis. Results of the mixed model procedures are presented in the following sections.

Food serving trips. The model generated for food serving trips (Table 14) accounted for 36% of the within- and 57% of the between-subjects

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[42] Whether or not participants found the video humorous, felt comfortable laughing during dining sessions, or enjoyed the meal was also explored, but because only a few participants responded negatively to these three survey items, they were omitted from analyses.
[43] As explained previously in the methods section, number of serving trips was entered as a covariate when analyzing amount served, and amount served was entered as a covariate when analyzing amount consumed.
[44] The sample size contained neither an adequate number of participants of varying ethnicities nor a wide range of income levels.

covariance (Table *27*, Appendix H). *Floor plan openness*, *social familiarity* (the two main IVs of interest), and interaction terms including those two variables accounted for 27% and 31%, respectively, of the within- and between-subjects covariances.[45]

Table 14. Mixed Model Results for Food Serving Trips

FOOD Serving Trips			
Variable	***(levels)^***	***Estimate (SE)***	***t-test Results***
Intercept		**2.65 *(.72)***	**$t_{(92)}$= 3.67, *p*=.000***
FLOOR PLAN OPENNESS	*(open/**closed**)*	**-1.44 *(.61)***	**$t_{(50)}$= -2.37, *p*=.022***
SOCIAL FAMILIARITY	*(strangers/**friends**)*	**0.90 *(.28)***	**$t_{(74)}$= 3.24, *p*=.002***
Education level	*(undergrad/**grad**)*	**-0.36 *(.17)***	**$t_{(52)}$= -2.08, *p*=.042***
Gender	*(male/**female**)*	**-2.03 *(.56)***	**$t_{(86)}$= -3.65, *p*=.000***
Social interaction	*(low/**high**)* *(med/**high**)*	0.07 *(.27)* 0.02 *(.25)*	$t_{(48)}$= 0.27, *p*=.786 $t_{(47)}$= 0.08, *p*=.936
BMI		0.02 *(.02)*	$t_{(80)}$= 0.66, *p*=.514
Dining group size		**-0.24 *(.06)***	**$t_{(77)}$= -4.04, *p*=.000***
FLOOR PLAN OPENNESS x SOCIAL FAMILIARITY		**0.50 *(.17)***	**$t_{(51)}$= 2.90, *p*=.006***
FLOOR PLAN OPENNESS x BMI		**0.06 *(.03)***	**$t_{(50)}$= 2.53, *p*=.015***
SOCIAL FAMILIARITY x Social interaction		**-0.77 *(.33)*** **-1.11 *(.33)***	**$t_{(66)}$= -2.31, *p*=.024*** **$t_{(80)}$= -3.38, *p*=.001***
Gender x Dining group size		**0.35 *(.09)***	**$t_{(81)}$= 3.86, *p*=.000***
Covariance explained by model		*Within-subjects*	**36.48%**
		Between-subjects	**56.56%**

^ *Bolded variable **level**= reference level*
CAPITAL LETTERS= *one of 2 main IVs of interest*
* *Indicates a statistically significant (p<0.05) estimate of the mean*
** *Indicates a statistically significant (p<0.01) estimate of the mean*
*** *Indicates a statistically significant (p<0.001) estimate of the mean*

[45] Covariances were calculated using the same formula displayed in Appendix H. Covariance explained by floor plan openness, social familiarity, and their associated interaction terms was calculated by subtracting the covariance explained by the model without those terms from the covariance explained by the full model.

As shown in Table 14, in addition to the main effects of *floor plan openness*, *social familiarity*, *gender*, and *dining group size*, *education level* was also a significant predictor in the food serving trip model. Graduate students made significantly more food serving trips than undergraduate students (1.92 v. 1.56). Hunger, contrary to hypotheses, was not a significant predictor in the model (p>0.05).

Examining interactions: Pairwise comparisons for food serving trips. Pairwise comparisons conducted on significant interactions, using Bonferroni adjusted alpha levels as noted,[46] are discussed below and illustrated in Tables 14a-14d.

- *Floor plan openness x social familiarity* (Table 14a). Pairwise comparisons revealed that differences in food serving trips between open and closed conditions were significant for strangers dining together (2.27 open v. 1.74 closed), but not for friends (1.49 open v. 1.47 closed). Effects of social familiarity on food serving trips were significant in the open, not closed, condition as strangers made significantly more food serving trips than friends (2.27 strangers v. 1.49 friends). Instead of floor plan openness affecting friends more than strangers as hypothesized, the opposite was found: strangers made more serving trips in the open condition than friends, and strangers also made more serving trips in the open versus closed condition when controlling for all other variables in the model.

[46] Unless otherwise noted, mean and pairwise comparisons for the food serving trips model variables were conducted using a mean BMI of 22.632 and mean dining group size of 5.92.

Table 14a. Pairwise Comparisons for the Interaction Between Floor Plan Openness and Social Familiarity on Food Serving Trips

Social familiarity	Floor plan openness		Bonferroni adjusted alpha level
	Open	Closed	
Strangers	2.27^{AC}	1.74^{Ad}	.05/4=.0125
Friends	1.49^{bC}	$1.47^{b\,d}$	

*"**AA**, **BB**" etc. indicate significant pairwise comparisons (p> Bonferroni adjusted alpha level)*
"aa, bb" etc. indicate insignificant pairwise comparisons (p< Bonferroni adjusted alpha level)

- *Floor plan openness x BMI* (Table 14b). Participants with BMIs between 19 and 32 (all but those with a BMI of 18) made more food serving trips in the open (v. closed) condition, but differences were only significant for participants with BMIs between 22 and 32. Pairwise comparisons[47] suggested that participants with BMIs of 22 or higher made significantly more food serving trips in the open, not closed condition (1.83 - 2.64 v. 1.59 - 1.75). Participants with lower BMIs (19-21) also made more food serving trips in the open condition than in the closed condition (1.59 - 1.75 v. 1.55 - 1.58), but the difference was not significant. Results indicated that BMIs between 22 and 32 were associated with a significant increase in food serving trips in the open condition.

Table 14b. Pairwise Comparisons for the Interaction Between Floor Plan Openness and BMI on Food Serving Trips

BMI *Mean=22.6* *Range=18.4 - 32.5*	Kitchen floor plan openness		Alpha Level
	Open	Closed	
18 - 21	$1.51 - 1.75^{a}$	$1.53 - 1.58^{a}$	0.05
≥22 - 32	$1.83 - 2.64^{B}$	$1.59 - 1.75^{B}$	

*"**AA**, **BB**" etc. indicate significant pairwise comparisons (p> alpha level)*
"aa, bb" etc. indicate insignificant pairwise comparisons (p< alpha level)

[47] Pairwise comparisons were conducted using whole numbers within the range of study sample participant BMIs (18, 19, 20…32). Findings were then displayed in tables by BMI range, based on resulting significant and insignificant comparisons.

- *Social familiarity x social interaction* (Table 14c). Strangers dining together experienced significant effects of social interaction more than friends dining together. Pairwise comparisons indicated significant differences in strangers' food serving trips between medium and high (1.51 v. 2.60) and low and high (1.90 v. 2.60) levels of social interaction. Differences in the stranger condition between low and medium levels (1.90 v. 1.51) were not significant. High levels of social interaction were, however, associated with significant differences in food serving trips between strangers and friends (2.60 v. 1.45). Results suggested that medium levels of social interaction may be associated with lower food serving trips for both strangers and friends, but that higher levels of social interaction may be associated with significantly fewer food serving trips for friends than strangers.

Table 14c. Pairwise Comparisons for the Interaction Between Social Familiarity and Social Interaction on Food Serving Trips

Social familiarity	**Social interaction**			**Bonferroni adjusted alpha level**
	Low	**Medium**	**High**	
Strangers	$1.90^{a\mathbf{C}g}$	$1.51^{a\mathbf{B}h}$	$2.60^{\mathbf{BCI}}$	.05/9=.006
Friends	1.52^{dfg}	1.47^{deh}	$1.45^{ef\mathbf{I}}$	

*"**AA**, **BB**" etc. indicate significant pairwise comparisons (p> Bonferroni adjusted alpha level)*
"aa, bb" etc. indicate insignificant pairwise comparisons (p< Bonferroni adjusted alpha level)

- *Gender x dining group size* (Table 14d). Pairwise comparisons showed that females made significantly more food serving trips than males (2.42 - 1.94 v. 1.44 - 1.66) in dining group sizes of three to five. Males made more food serving trips than females only among dining group sizes of six or seven (rather than three to five), but the results were not significant (1.77 – 1.88 v. 1.70 – 1.47). This suggested that although males made more food serving trips than females overall, the relationship depended on dining group size. Males made more, but females made fewer, food serving trips as dining group size increased.

Table 14d. Pairwise Comparisons for the Interaction Between Gender and Dining Group Size on Food Serving Trips

Dining group size *(Mean=6, Range=3-7)*	**Gender**		**Alpha level**
	Male	**Female**	
3-5	1.44 - 1.66[A]	2.42 - 1.94[A]	0.05
6-7	1.77 - 1.88[b]	1.70 - 1.47[b]	

*"**AA**, **BB**" etc. indicate significant pairwise comparisons (p> alpha level)*
"aa, bb" etc. indicate insignificant pairwise comparisons (p< alpha level)

Beverage serving trips. The beverage serving trip model (Table 15) accounted for 17% of the within- and 21% of the between-subjects covariance (Table 27, Appendix H). *Floor plan openness*, *social familiarity* (the two main IVs of interest), and interaction terms including those two variables accounted for 17% and -38%,[48] respectively, of the within- and between-subjects covariances.[49]

As shown in Table 15, main effects of *gender* and *BMI* were significant predictors; hunger, contrary to hypotheses, was not a significant predictor (*p*>0.05). Education level, social interaction, and dining group size were also not significant predictors of beverage serving trips, unlike the food serving trips model.

[48] The positive within-subjects covariance indicated that as participants went from the closed (coded as 0) to open condition (coded as 1), beverage serving trips increased. The negative between-subjects covariance indicated that participants dining with strangers (coded as 0) made more serving trips than friends (coded as 1).
[49] Covariances were calculated using the same formula displayed in Appendix H. Covariance explained by floor plan openness, social familiarity, and their associated interaction terms was calculated by subtracting the covariance explained by the model without those terms from the covariance explained by the full model.

Table 15. Mixed Model Results for Beverage Serving Trips

BEVERAGE Serving Trips			
Predictor Term	***(levels)^***	***Estimate (SE)***	***t-test Results***
Intercept		**2.05 *(.45)***	**$t_{(76)}$= 4.55, p=.000*****
FLOOR PLAN OPENNESS	*(open/**closed**)*	-0.77 *(.41)*	$t_{(53)}$= -1.91, p=.062
SOCIAL FAMILIARITY	*(strangers/**friends**)*	-0.01 *(.09)*	$t_{(98)}$= 0.17, *p*=.869
Gender	*(male/**female**)*	**-1.29 *(.53)***	**$t_{(51)}$= -2.42, *p*=.019***
BMI		**-0.05 *(.02)***	**$t_{(73)}$= -2.41, *p*=.019***
FLOOR PLAN OPENNESS x SOCIAL FAMILIARITY		**-0.25 *(.11)***	**$t_{(53)}$= -2.23, *p*=.030***
FLOOR PLAN OPENNESS x BMI		**0.04 *(.02)***	**$t_{(53)}$= 2.55, *p*=.014***
Gender x BMI		**0.06 *(.02)***	**$t_{(51)}$= 2.68, *p*=.010***
Covariance explained by model		*Within-subjects*	**17.06%**
		Between-subjects	**21.35%**

^ *Bolded variable **level**= reference level*
CAPITAL LETTERS= *one of 2 main IVs of interest*
* *Indicates a statistically significant (p<0.05) estimate of the mean*
*** *Indicates a statistically significant (p<0.001) estimate of the mean*

<u>*Examining interactions: Pairwise comparisons for beverage serving*</u> <u>*trips*</u>. The pairwise comparisons conducted on significant interactions, using Bonferroni adjusted alpha levels as noted,[50] are discussed below and illustrated in Tables 15a-15c.

- *Floor plan openness x social familiarity* (Table 15a). Participants dining with friends made more beverage serving trips than strangers in both the open and closed conditions. Pairwise comparisons, however, indicated that differences in beverage serving trips were only significant in the open condition (1.03 strangers v. 1.32 friends). Friends in the

[50] Unless otherwise noted, pairwise comparisons for the beverage serving trips model variables were conducted using a mean BMI of 22.632.

open condition also made more beverage serving trips than friends in the closed condition (1.32 v. 1.11), and strangers made slightly less beverage serving trips in the open versus closed condition (1.03 v. 1.07), but the differences were insignificant.

Table 15a. Pairwise Comparisons for the Interaction Between Floor Plan Openness and Social Familiarity on Beverage Serving Trips

Social familiarity	Floor plan openness		Bonferroni adjusted alpha level
	Open	Closed	
Strangers	1.03[aC]	1.07[ad]	.05/4=.0125
Friends	1.32[bC]	1.11[bd]	

*"**AA**, **BB**" etc. indicate significant pairwise comparisons (p> Bonferroni adjusted alpha level)*
"aa, bb" etc. indicate insignificant pairwise comparisons (p< Bonferroni adjusted alpha level)

- *Floor plan openness x BMI* (Table 15b).[47] In the open condition, beverage serving trips increased with an increase in BMI, similar to the food serving trip model; but, unlike the food serving trip model, beverage serving trips decreased in the closed condition with an increase in BMI. Participants with higher BMIs (21-32) made more beverage serving trips than those with lower BMIs (18-20) in the open versus closed condition. Pairwise comparisons, however, revealed that results were only significant for participants with BMIs between 24 and 32 (1.21 - 1.40 open v. 1.07 – 0.90 closed).

Table 15b. Pairwise Comparisons for the Interaction Between Floor Plan Openness and BMI on Beverage Serving Trips

BMI *Mean=22.6* *Range=18.4 - 32.5*	Kitchen floor plan openness		Alpha level
	Open	Closed	
18 - 23	1.07 - 1.19[a]	1.19 - 1.09[a]	0.05
≥24 - 32	1.21 - 1.40[B]	1.07 - 0.90[B]	

*"**AA**, **BB**" etc. indicate significant pairwise comparisons (p> alpha level)*
"aa, bb" etc. indicate insignificant pairwise comparisons (p< alpha level)

- *Gender x BMI* (Table 15c). A positive association between BMI and beverage serving trips was found for males, but a negative association was found for females. Males made fewer beverage serving trips than females (1.05 – 1.11 males v. 1.20 – 1.15 females) when BMI was low (18-20), but the difference was not significant. However, males made significantly more beverage serving trips than females (1.14 – 1.47 males v. 1.12 – 0.83 females) when BMI was higher (21-32); but, the difference was only significant when BMI was between 24 and 32.

Table 15c. Pairwise Comparisons for the Interaction Between Gender and BMI on Beverage Serving Trips

BMI *Mean=22.6* *Range=18.4 - 32.5*	**Gender**		**Alpha level**
	Male	**Female**	
18 - 23	1.05 - 1.20[a]	1.20 - 1.07[a]	0.05
≥24 - 32	1.23 - 1.47[B]	1.04 - 0.83[B]	

*"**AA**, **BB**" etc. indicate significant pairwise comparisons (p> alpha level)*
"aa, bb" etc. indicate insignificant pairwise comparisons (p< alpha level)

Total food and beverage serving trips. Forty-seven percent of the within- and 46% of the between-subjects covariance (Table 27, Appendix H) was explained by the total food and beverage serving trip model (Table 16). *Floor plan openness, social familiarity* (the two main IVs of interest), and interaction terms including those two variables accounted for 34% and 19%, respectively, of the within- and between-subjects covariances.[51]

[51] Covariances were calculated using the same formula displayed in Appendix H. Covariance explained by floor plan openness, social familiarity, and their associated interaction terms was calculated by subtracting the covariance explained by the model without those terms from the covariance explained by the full model.

Table 16. Mixed Model Results for Total Serving Trips

TOTAL Serving Trips			
Predictor Term	***(levels)^***	***Estimate (SE)***	***t-test Results***
Intercept		**2.61 *(.95)***	$\boldsymbol{t_{(97)}}$**= 2.74, p=.007****
FLOOR PLAN OPENNESS	*(open/**closed**)*	**-1.65 *(.65)***	$\boldsymbol{t_{(50)}}$**= -2.53, p=.014***
SOCIAL FAMILIARITY	*(strangers/**friends**)*	**3.12 *(.78)***	$\boldsymbol{t_{(74)}}$**= 4.02, *p*=.000*****
Education level	*(undergrad/**grad**)*	**-0.54 *(.20)***	$\boldsymbol{t_{(52)}}$**= -2.74, *p*=.008****
Gender	*(male/**female**)*	**-2.16 *(.63)***	$\boldsymbol{t_{(86)}}$**= -3.46, *p*=.001****
Social interaction	*(low/**high**)* *(med/**high**)*	-0.04 *(.31)* 0.36 *(.28)*	$t_{(50)}$= -0.12, *p*=.905 $t_{(48)}$= 1.29, *p*=.202
BMI		-0.00 *(.03)*	$t_{(79)}$= -0.08, *p*=.935
Dining group size		-0.00 *(.11)*	$t_{(57)}$= -0.21, *p*=.983
FLOOR PLAN OPENNESS x BMI		**0.09 *(.03)***	$\boldsymbol{t_{(50)}}$**= 3.13, *p*=.003****
SOCIAL FAMILIARITY x Social interaction		**-0.90 *(.38)*** **-1.66 *(.38)***	$\boldsymbol{t_{(66)}}$**= -2.39, *p*=.020*** $\boldsymbol{t_{(82)}}$**= -4.41, *p*=.000*****
SOCIAL FAMILIARITY x Dining group size		**-0.31 *(.11)***	$\boldsymbol{t_{(60)}}$**= -2.70, *p*=.009****
Gender x Dining group size		**0.39 *(.10)***	$\boldsymbol{t_{(81)}}$**= 3.89, *p*=.000*****
Covariance explained by model		*Within-subjects*	**47.01%**
		Between-subjects	**45.54%**

^ *Bolded variable **level**= reference level*
CAPITAL LETTERS= *one of 2 main IVs of interest*
* *Indicates a statistically significant (p<0.05) estimate of the mean*
** *Indicates a statistically significant (p<0.01) estimate of the mean*
*** *Indicates a statistically significant (p<0.001) estimate of the mean*

Table 16 indicates that, in addition to the main effects of *floor plan openness*, *social familiarity*, and *gender*, *education level* was also a significant predictor of total food and beverage serving trips. Undergrads made significantly fewer trips than graduate students (2.62 v. 3.16). Contrary to hypotheses, hunger was not a significant predictor in the model.

Examining interactions: Pairwise comparisons for total serving trips.

Tables 16a-16d illustrate pairwise comparisons, using Bonferroni adjusted alpha levels as noted,[52] conducted on significant interactions in the total serving trips model.

- *Floor plan openness x BMI* (Table 16a).[47] Similar to the beverage serving trip model, total food and beverage serving trips increased in open condition, but decreased in the closed condition, as BMI increased. Pairwise comparisons suggested that participants with higher BMIs (21-32) were more affected by floor plan openness than participants with lower BMIs (18-20). All participants, except for those with a BMI of 18, made more total serving trips in the open versus closed condition, but the differences were only significant for participants with BMIs between 21 and 32 (2.93 – 3.89 open v. 2.71 – 2.68 closed).

Table 16a. Pairwise Comparisons for the Interaction Between Floor Plan Openness and BMI on Total Serving Trips

BMI *Mean=22.6* *Range=18.4 - 32.5*	**Kitchen floor plan openness**		**Alpha level**
	Open	**Closed**	
18 - 20	2.67 – 2.85[a]	2.72 – 2.71[a]	0.05
≥21 - 32	2.93 – 3.89[B]	2.71 – 2.68[B]	

*"**AA**, **BB**" etc. indicate significant pairwise comparisons (p> alpha level)*
"aa, bb" etc. indicate insignificant pairwise comparisons (p< alpha level)

- *Social familiarity x social interaction* (Table 16b). Results from pairwise comparisons indicated significant differences in strangers' total serving trips between low and high (2.93 v. 3.87), and medium and high (2.56 v.

[52] Unless otherwise noted, mean and pairwise comparisons for the total serving trips model variables were conducted using a mean BMI of 22.632 and mean dining group size of 5.92.

3.87) levels of social interaction. Differences in the stranger condition between low and medium levels (2.93 v. 2.56) were not significant. The three pairwise comparisons between low, medium, and high levels of social interaction for participants dining with friends were also all insignificant. High levels of social interaction were, however, associated with significant differences in total serving trips between strangers and friends (3.87 v. 2.55). Results suggested that medium levels of social interaction may be associated with lower total serving trips for strangers, but also that higher levels of social interaction may be associated with significantly more and less food serving trips for strangers and friends, respectively.

Table 16b. Pairwise Comparisons for the Interaction Between Social Familiarity and Social Interaction on Total Serving Trips

Social familiarity	Social interaction			Bonferroni adjusted alpha level
	Low	Medium	High	
Strangers	$2.93^{a\mathbf{C}g}$	$2.56^{a\mathbf{B}h}$	$3.87^{\mathbf{BCI}}$	.05/9=.006
Friends	$2.52^{d\ f\ g}$	2.91^{deh}	$2.55^{e\ f\ \mathbf{I}}$	

*"**AA**, **BB**" etc. indicate significant pairwise comparisons (p> Bonferroni adjusted alpha level)*
"aa, bb" etc. indicate insignificant pairwise comparisons (p< Bonferroni adjusted alpha level)

- *Social familiarity x dining group size* (Table 16c). Participants dining with strangers made significantly more total serving trips than participants dining with friends for all dining group sizes, but pairwise comparisons indicated larger and significant differences for dining group sizes between three and six, not seven (3.45 – 3.11 strangers v. 2.09 – 2.68 friends). Results suggested that an increase in dining group size was associated with a decrease in total serving trips for strangers, but also with an increase in total serving trips for friends.

Table 16c. Pairwise Comparisons for the Interaction Between Social Familiarity and Dining Group Size on Total Serving Trips

Dining group size *(Mean=6, Range=3-7)*	**Social familiarity**		**Alpha level**
	Strangers	**Friends**	
3-6	3.45 – 3.11[A]	2.09 – 2.68[A]	0.05
7	3.00[b]	2.87[b]	

*"**AA**, **BB**" etc. indicate significant pairwise comparisons (p> alpha level)*
"aa, bb" etc. indicate insignificant pairwise comparisons (p< alpha level)

- *Gender x dining group size* (Table 16d). An increase in dining group size was associated with an increase in total serving trips made by males, but also a decrease in total serving trips made by females. Pairwise comparisons showed that males made fewer total serving trips than females in smaller dining group sizes of three and four (2.28 – 2.52 v. 3.26 – 3.10). Males made more total serving trips in dining group sizes of 5-7 than females, but the differences were larger and only significant in dining group sizes of seven (3.24 male v. 2.64 female).

Table 16d. Pairwise Comparisons for the Interaction Between Gender and Dining Group Size on Total Serving Trips

Dining group size *(Mean=6, Range=3-7)*	**Gender**		**Alpha level**
	Male	**Female**	
3-4	2.28 - 2.52[A]	3.26 – 3.10[A]	0.05
5-6	2.76 - 3.00[b]	2.95 - 2.79[b]	
7	3.24[C]	2.64[C]	

*"**AA**, **BB**" etc. indicate significant pairwise comparisons (p> alpha level)*
"aa, bb" etc. indicate insignificant pairwise comparisons (p< alpha level)

Amount served (food). The grams of food served model (Table 17, left) accounted for 36% of the within- and 61% of the between-subjects covariance Table 28, Appendix H). The calories of food served model (Table 17, right) accounted for 42% of the within- and 61% of the between-subjects covariance (Table 29, Appendix H). Floor plan openness and social familiarity (the two main IVs of interest) were not significant in the grams or calories of food served models.

Table 17 (left) indicates significant main effects of *education level*, *gender*, and *hunger*[53] on grams of food served. Hungry participants served significantly more grams of food than non-hungry participants (482.01 v. 374.35 grams). The right side of Table 17 illustrates that, in addition to significant main effects of *education level*, *hunger*,[53] *BMI*, and *food serving trips*, *gender* was also a significant predictor of food served (calories). Males served significantly more calories than females (728.51 v. 503.92 calories).

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[53] Because only two participants dining with friends responded that they were “somewhat” hungry, these responses were included as “yes” (hungry), and only two levels of hunger were considered.

Table 17. Mixed Model Results for Amount of Food Served *(grams and calories)*

FOOD Served (*grams*)			FOOD Served (*calories*)		
Variable *(levels)^*	***Estimate (SE)***	***t-test Results***	***Variable*** *(levels)^*	***Estimate (SE)***	***t-test Results***
Intercept	**434.03 *(93.35)***	**$t_{(100)}$= 3.06, p=.003****	Intercept	-463.24 *(384.81)*	$t_{(101)}$= -1.20, p=..231
Education level *(undergrad/**grad**)*	**-272.05 *(100.85)***	**$t_{(101)}$= -2.70, p=.008****	Education level *(undergrad/**grad**)*	**-263.46 *(73.27)***	**$t_{(59)}$= -3.60, p=.001****
Gender *(male/**female**)*	**255.97 *(77.19)***	**$t_{(60)}$= 3.32, *p*=.002****	Gender *(male/**female**)*	**223.06 *(57.72)***	**$t_{(52)}$= 3.87, *p*=.000*****
Hunger *(no/**yes**)*	**-107.66 *(24.53)***	**$t_{(78)}$= -4.39, *p*=.000*****	Hunger *(no/**yes**)*	**-574.66 *(186.89)***	**$t_{(77)}$= -3.08, *p*=.003****
Food serving trips	8.56 *(41.29)*	$t_{(105)}$= 0.21, *p*=.836	BMI	**42.70 *(16.78)***	**$t_{(102)}$= 2.55, *p*=.012***
Education level x Gender	**-170.93 *(84.51)***	**$t_{(58)}$= -2.02, *p*=.048***	Food serving trips	**706.15 *(172.20)***	**$t_{(98)}$= 4.10, *p*=.000*****
Education level x Food serving trips	**100.96 *(45.61)***	**$t_{(105)}$= 2.21, *p*=.029***	Education level x Hunger	**406.83 *(192.00)***	**$t_{(77)}$= 2.12, *p*=.037***
			BMI x Food serving trips	**-22.25 *(7.19)***	**$t_{(98)}$= -3.09, *p*=.003****
Covariance explained by model	*Within-subjects*	**36.36%**	**Covariance explained by model**	*Within-subjects*	**41.91%**
	Between-subjects	**61.20%**		*Between-subjects*	**61.33%**

^ *Bolded variable **level**= reference level*
* *Indicates a statistically significant (p<0.05) estimate of the mean*
** *Indicates a statistically significant (p<0.01) estimate of the mean*
*** *Indicates a statistically significant (p<0.001) estimate of the mean*

Examining interactions: Pairwise comparisons for food served (grams). Pairwise comparisons conducted on significant interactions in the grams of food served model, using Bonferroni adjusted alpha levels as noted,[54] are displayed in Tables 17a-17b.

- *Education level x gender* (Table 17a). All graduate students served more food than undergraduate students, but the difference was only significant for males. Pairwise comparisons indicated that male graduate students served significantly more than undergraduate male students (650.49 v. 376.37 grams). Males also served more food than females overall, but male graduate students served significantly more food than female graduate students (650.49 v. 394.52 grams). The difference between female graduate and female undergraduate students was insignificant (394.52 v. 291.33 grams). These results confirmed hypotheses that males served more than females, and also suggested that being a graduate student male was associated with a further increase in amount served.

***Table 17a. Pairwise Comparisons for the Interaction Between Gender and Education Level on Food Served** (grams)*

Education level	Gender		Bonferroni adjusted alpha level
	Male	Female	
Undergraduate	376.37[aC]	291.33[ad]	0.05/4=.0125
Graduate	650.49[BC]	394.52[Bd]	

*"**AA, BB**" etc. indicate significant pairwise comparisons (p> alpha level)*
"aa, bb" etc. indicate insignificant pairwise comparisons (p< alpha level)

[54] Unless otherwise noted, mean and pairwise comparisons for the grams of food served model variables were conducted using a mean of 1.67 food serving trips.

- *Education level x food serving trips* (Table 17b). An increase in food serving trips from one to four was associated with more food served (grams). Pairwise comparisons showed that graduate students served more food than undergraduates when food serving trips were between one and three, but differences were only significant for one and two food serving trips (260.19 – 369.71 undergraduate v. 516.75 – 525.31 graduate grams). This indicated that differences in serving size between graduate and undergraduate students were significantly larger when serving trips were between one and two, but not three and four.

Table 17b. Pairwise Comparisons for the Interaction Between Education Level and Food Serving Trips on Food Served *(grams)*

Food serving trips	Education Level		Alpha level
	Undergraduate	Graduate	
1-2	260.19 - 369.71^{A}	516.75 - 525.31^{A}	0.05
3-4	479.23 - 588.74^{b}	533.87 - 542.44^{b}	

*"**AA**, **BB**" etc. indicate significant pairwise comparisons (p> alpha level)*
"aa, bb" etc. indicate insignificant pairwise comparisons (p< alpha level)

Examining interactions: Pairwise comparisons for food served (calories). Pairwise comparisons conducted on significant interactions in the calories of food served model, using Bonferroni adjusted alpha levels as noted,[55] are displayed in Table 17c.

- *Education level x hunger* (Table 17c). Pairwise comparisons indicated that both hungry undergraduate (690.93 hungry v. 523.10 not hungry calories) and hungry graduate students (954.39 hungry v. 379.73 not hungry calories) served significantly more food calories than

[55] Unless otherwise noted, mean and pairwise comparisons for the food served (calories) model were conducted using a mean BMI of 22.632 and 1.67 mean food serving trips.

undergraduate and graduate students who were not hungry. Furthermore, hungry graduate students served significantly more food calories than hungry undergraduate students (954.39 v. 690.93 calories). This indicated that hunger was associated with an increase in calories served for both undergraduate and graduate students, but especially for graduate students.

Table 17c. Pairwise Comparisons for the Interaction Between Education Level and Hunger on Food Served *(calories)*

Hunger	Education level		Bonferroni adjusted alpha level
	Undergraduate	Graduate	
No	523.10[aC]	379.73[aD]	.05/4=.0125
Yes	690.93[BC]	954.39[BD]	

*"**AA**, **BB**" etc. indicate significant pairwise comparisons (p> alpha level)*
"aa, bb" etc. indicate insignificant pairwise comparisons (p< alpha level)

- *BMI x food serving trips*. The interaction between BMI and food serving trips was only significant for one food serving trip. Increasing BMI by one increased calories of food served by 43.19 calories. One serving trip was associated with a decrease in calories of food served by only 22.47 grams. Two serving trips, however, was associated with a decrease in calories of food served by 44.94 grams, which is greater than 43.19, indicating that there was no effect of BMI after one food serving trip.

Amount served (beverage).[56] Seventy-four percent of the within- and 14% of the between-subjects covariance (Table 28, Appendix H) was explained by the beverage served model. As shown in Table 18, *education level*, *social interaction*, and *beverage serving trips* were significant predictors of beverage served (grams), but floor plan openness and social familiarity (the two main IVs of interest) were not.

Table 18. Mixed Model Results for Amount of Beverage Served
(grams and calories^^)

BEVERAGE Served (*grams*)			
Variable	***(levels)^***	***Estimate (SE)***	***t-test Results***
Intercept		96.62 *(78.94)*	$t_{(106)}$= 1.22, p=.224
Education level	*(undergrad/**grad**)*	**185.53 *(77.23)***	**$t_{(103)}$= 2.40, p=.018***
Social interaction	*(low/**medium**)* *(low/**high**)*	**-273.91 *(96.28)*** -112.05 *(99.95)*	**$t_{(106)}$= -2.85, *p*=.005**** $t_{(106)}$= -1.12, *p*=.265
Beverage serving trips		**380.15 *(63.08)***	**$t_{(103)}$= 6.03, *p*=.000*****
Education level x Beverage Serving Trips		**-180.05 *(66.97)***	**$t_{(100)}$= -2.69, *p*=.008****
Social interaction x Beverage Serving Trips		**-231.63 *(88.31)*** 56.57 *(89.61)*	**$t_{(104)}$= 2.62, *p*=.010*** $t_{(104)}$= 0.63, *p*=.529
Covariance explained by model		*Within-subjects*	**74.16%**
		Between-subjects	**13.59%**

*^ Bolded variable **level**= reference level*
^^ Only regular soda contained calories, so no model was generated for beverage calories served.
** Indicates a statistically significant (p<0.05) estimate of the mean*
*** Indicates a statistically significant (p<0.01) estimate of the mean*
**** Indicates a statistically significant (p<0.001) estimate of the mean*

[56] Beverages offered to participants were contained in a diet soda can, regular soda can, or water bottle, each with its own respective weight of liquid. Because a serving trip was defined by serving one beverage container and no participant served more than one beverage per trip (i.e., all participants who made two beverage serving trips served two beverages), the beverage grams and calories served variables were not truly continuous variables.

Examining interactions: Pairwise comparisons for beverage served (grams). Pairwise comparisons, using Bonferroni adjusted alpha levels as noted, were conducted on significant interactions and are displayed in Tables 18a-18b.

- *Education level x beverage serving trips* (Table 18a). Pairwise comparisons found that graduate students served more grams of beverage than undergraduate students when two and three (not one) beverage serving trips were made (920.41 v. 745.84 grams for two beverage serving trips; 1396.64 v. 1042.02 grams for three beverage serving trips). Results were not significant for one beverage serving trip.

Table 18a. Pairwise Comparisons for the Interaction Between Education Level and Beverage Serving Trips on Beverage Served *(grams)*

Beverage serving trips	Education level		Alpha level
	Undergraduate	Graduate	
1	449.67[a]	444.19[a]	0.05
2	745.84[B]	920.41[B]	
3	1042.02[C]	1396.64[C]	

*"**AA, BB**" etc. indicate significant pairwise comparisons (p> alpha level)*
"aa, bb" etc. indicate insignificant pairwise comparisons (p< alpha level)

- *Social interaction x beverage serving trips* (Table 18b). Participants dining during low levels of social interaction served more grams of beverage than those in medium or high levels when making two and three beverage serving trips. Results, however, were only significant between low and medium social interaction levels for two beverage serving trips (959.00 low v. 770.74 high), and between all social interaction levels for three beverage serving trips (1480.76 low, 1117.44 medium, 1059.77 high). Participants dining during high levels of social interaction, on the other hand, served more beverage than those dining during low and medium social interaction levels when making one beverage serving trip, but results were not significant.

Table 18b. Pairwise Comparisons for the Interaction Between Social Interaction and Beverage Serving Trips on Beverage Served *(grams)*

Beverage serving trips	Social interaction			Bonferroni adjusted alpha level
	Low	Medium	High	
1	437.42[ab]	424.04[ac]	479.51[bc]	.05/3=.017
2	959.00[**De**]	770.74[**Df**]	769.64[ef]	
3	1480.76[**GH**]	1117.44[**Gi**]	1059.77[**Hi**]	

*"**AA**, **BB**" etc. indicate significant pairwise comparisons (p> Bonferroni adjusted alpha level)*
"aa, bb" etc. indicate insignificant pairwise comparisons (p< Bonferroni adjusted alpha level)

Amount served (total food and beverage). The grams of total food and beverage served model (Table 19) accounted for 66% of the within- and 41% of the between-subjects covariance (Table 28, Appendix H). Only one of the two main IVs of interest, *floor plan openness*, was significant in the model. Floor plan openness and associated interactions accounted for 14% and -8%,[57] respectively, of the within- and between-subjects covariances.[58] Social familiarity was not significant. Table 19 (left) indicates significant main effects of *floor plan openness*, *education level*, *hunger*,[59] and *total serving trips* for

[57] The positive within-subjects covariance indicated that as participants went from the closed (coded as 0) to open condition (coded as 1), total food and beverage grams served increased. The negative between-subjects covariance relates to the floor plan openness by gender interaction, and reflects that male participants (coded as 0) and female participants (coded as 1) were affected by floor plan openness differently: females served less, but males served more total food and beverage grams in the open v. closed condition.
[58] Covariances were calculated using the same formula displayed in Appendix H. Covariance explained by floor plan openness, social familiarity, and their associated interaction terms was calculated by subtracting the covariance explained by the model without those terms from the covariance explained by the full model.
[59] Because only two participants dining with friends responded that they were "somewhat" hungry, these responses were included as "yes" (hungry), and only two levels of hunger were considered.

total grams of combined food and beverage served. With each additional serving trip, an additional 175.47 grams was served.

The calories of total food and beverage served model (Table 19, right) accounted for 35% of the within- and 59% of the between-subjects covariance (Table 29, Appendix H), but neither floor plan openness nor social familiarity were significant predictors in this model. The right side of Table 19 displays significant main effects of *education level*, *gender*, *hunger*,[59] and *total serving trips* for total calories of combined food and beverage served: undergraduate students served significantly less calories than graduate students (658.15 v. 868.60 calories); males served significantly more than females (893.92 v. 631.83 calories); and hungry participants served significantly more calories than non-hungry participants (857.22 v. 668.53 calories).[60]

[60] Mean comparisons for the total served (calories) model variables were conducted using a mean BMI of 22.632 and a mean total serving trips of 2.75.

Table 19. Mixed Model Results for Total Amount Served *(grams and calories)*

TOTAL Served (*grams*)			**TOTAL Served (*calories*)**		
Variable *(levels)^*	***Estimate (SE)***	***t-test Results***	***Variable*** *(levels)^*	***Estimate (SE)***	***t-test Results***
Intercept	**521.69 *(83.69)***	**$t_{(102)}$= 6.23, p=.000*** **	Intercept	-553.16 *(526.75)*	$t_{(103)}$= -1.05, p=.296
FLOOR PLAN OPENNESS *(open/**closed**)*	**-85.92 *(27.35)***	**$t_{(53)}$= -3.14, p=.003** **	Education level *(undergrad/**grad**)*	**-211.45 *(77.91)***	**$T_{(58)}$= -2.71, p=.009** **
Education level *(undergrad/**grad**)*	**-149.54 *(55.63)***	**$t_{(62)}$= -2.69, *p*=.009** **	Gender *(male/**female**)*	**262.10 *(62.10)***	**$t_{(52)}$= 4.22, *p*=.000*** **
Gender *(male/**female**)*	44.84 *(46.38)*	$t_{(81)}$= 0.97, *p*=.337	Hunger *(no/**yes**)*	**-188.69 *(47.64)***	**$t_{(79)}$= -3.96, *p*=.000*** **
Hunger *(no/**yes**)*	**-512.39 *(144.04)***	**$t_{(79)}$= -3.56, *p*=.001** **	BMI	39.11 *(21.86)*	$t_{(102)}$= 1.79, *p*=.077
Total serving trips	**175.47 *(19.89)***	**$t_{(94)}$= 8.82, *p*=.000*** **	Total serving trips	**532.22 *(157.49)***	**$t_{(93)}$= 3.38, *p*=.001** **
FLOOR PLAN OPENNESS x Gender	**112.02 *(43.51)***	**$t_{(52)}$= 2.57, *p*=.013* **	BMI x Total Serving Trips	**-15.51 *(6.29)***	**$t_{(90)}$= -2.47, *p*=.016* **
Education level x Hunger	**390.08 *(147.53)***	**$t_{(78)}$= 2.64, *p*=.010* **			
Covariance explained by model	*Within-subjects*	**65.78%**	**Covariance explained by model**	*Within-subjects*	**34.96%**
	Between-subjects	**41.03%**		*Between-subjects*	**59.13%**

^ *Bolded variable **level**= reference level*
CAPITAL LETTERS= *one of 2 main IVs of interest*
* *Indicates a statistically significant (p<0.05) estimate of the mean*
** *Indicates a statistically significant (p<0.01) estimate of the mean*
*** *Indicates a statistically significant (p<0.001) estimate of the mean*

Examining interactions: Pairwise comparisons for total served (grams). Pairwise comparisons conducted on significant interactions in the total grams of food and beverage served model, using Bonferroni adjusted alpha levels as noted,[61] are displayed in Tables 19a-19b.

- *Floor plan openness x gender* (Table 19a). Pairwise comparisons revealed that males served more than females in both the open (842.10 v. 685.25 grams) and closed (816.01 v. 771.17 grams) conditions, but differences were only significant in the open condition. Contrary to expectations, only males served more in the open versus closed conditions (842.10 v. 816.01 grams), but the difference was not significant. Females actually served significantly less combined food and beverage in the open, rather than closed, condition (685.25 v. 771.17 grams), which suggested that floor plan openness may have opposing effects on females and males.

Table 19a. Pairwise Comparisons for the Interaction Between Floor Plan Openness and Gender on Total Served *(grams)*

Gender	Floor plan openness		Bonferroni adjusted alpha level
	Open	Closed	
Male	842.10[aC]	816.01[ad]	.05/4=.0125
Female	685.25[BC]	771.17[Bd]	

*"**AA**, **BB**" etc. indicate significant pairwise comparisons (p> alpha level)*
"aa, bb" etc. indicate insignificant pairwise comparisons (p< alpha level)

- *Education level x hunger* (Table 19b). Pairwise comparisons suggested that both hungry undergraduate (862.65 hungry v. 740.13 not hungry grams) and hungry graduate students (1012.08 hungry v. 499.69 not

[61] Unless otherwise noted, pairwise comparisons for the total served (grams) model variables were conducted using a total serving trips mean of 2.75.

hungry grams) served significantly more grams of combined food and beverage than non-hungry undergraduate and graduate students, respectively. Differences in total food and beverage served were also significant between hungry undergraduate and graduate students (862.54 v. 1012.08 grams), but not non-hungry undergraduate and graduate students (740.23 v. 499.69 grams). Results suggested that hunger was associated with an increase in total food and beverage served for both undergraduate and graduate students, but especially for graduate students.

Table 19b. Pairwise Comparisons for the Interaction Between Education Level and Hunger on Total Served *(grams)*

Hunger	Education level		Bonferroni adjusted alpha level
	Undergraduate	Graduate	
No	740.23^{aC}	499.69^{aD}	.05/4=.0125
Yes	862.54^{BC}	1012.08^{BD}	

*"**AA**, **BB**" etc. indicate significant pairwise comparisons (p> alpha level)*
"aa, bb" etc. indicate insignificant pairwise comparisons (p< alpha level)

Examining interactions for total food and beverage served (calories): BMI x total Serving Trips. The interaction between BMI and total serving trips was only significant for one and two total food and beverage serving trips. Increasing BMI by one was associated with an increase in total calories served of 39.71 calories. One and two total serving trips were associated with decreases of 15.67 and 31.34 total calories served, respectively. Three serving trips, however, were associated with a decrease in total calories served of 47.01, which is greater than 39.71. This indicated that there were no effects of BMI after two combined food and beverage serving trips.

Amount consumed (food). The grams of food consumed model (Table 20, left) accounted for 98% of the within- and 99% of the between-subjects covariance (Table 30, Appendix H).[62] Similarly, the calories of food served model (Table 20, right) also accounted for 98% of the within- and 100% of the between-subjects covariance (Table 31, Appendix H).[63] Floor plan openness and social familiarity (the two main IVs of interest) were not significant in either the grams or calories of food consumed models. The left side of Table 20 illustrates main effects of *education level*, *gender*, *amount of food served* and *dining group size* on grams of food consumed. Significantly less food was consumed by undergraduate versus graduate students (357.10 v. 373.07 grams), and males consumed significantly more than females (370.37 v. 359.80 grams). The amount of food consumed increased with an increase in food served;[64] however, the amount of food consumed decreased as dining group size increased from three to seven (380.04 – 359.56 grams).

Education level, *gender*, *amount of food calories served*, and *dining group size* were significant predictors of calories of food consumed (Table 20, right). Undergraduates consumed significantly less calories than graduate students (628.38 v. 653.43 calories). Males consumed significantly more calories than females (650.19 v. 631.32 calories). An increase in food calories served was associated with an increase in food calories consumed,[65] but calories consumed decreased with an increase in dining group size from three to seven (665.86 - 631.69 calories).

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[62] Mean comparisons for the food consumed (grams) model variables were calculated using mean values: BMI= 22.632, amount food served= 377.88 grams, and dining group size= 5.92.
[63] Mean comparisons for the food consumed (cals.) model variables were calculated using mean values: BMI= 22.632, amount food served= 657.61 cals., and dining group size = 5.92.
[64] Participants consumed 98% of food grams served (mean: BMI=22.632, serving trips=2.75).
[65] Participants consumed 97% of food cals. served (mean: BMI=22.632, serving trips=2.75).

Table 20. Mixed Model Results for Amount of Food Consumed *(grams and calories)*

FOOD Consumed (*grams*)			**FOOD Consumed (*calories*)**		
Variable *(levels)^*	***Estimate (SE)***	***t-test Results***	***Variable*** *(levels)^*	***Estimate (SE)***	***t-test Results***
Intercept	28.73 *(13.42)*	$t_{(109)}$= 2.14, p=.035	Intercept	**53.74 *(23.04)***	**$t_{(109)}$= 2.33, p=.021***
Education level *(undergrad/**grad**)*	**-15.96 *(6.37)***	**$t_{(60)}$= -2.51, p=.015***	Education level *(undergrad/**grad**)*	**-21.05 *(10.21)***	**$t_{(59)}$= -2.45, p=.017***
Gender *(male/**female**)*	**10.56 *(4.70)***	**$t_{(56)}$= 2.25, p=.028***	Gender *(male/**female**)*	**18.58 *(7.75)***	**$t_{(58)}$= 2.40, p=.020***
Food served (grams)	**0.98 *(0.01)***	**$t_{(104)}$= 76.58, p=.000*****	Food served (calories)	**0.97 *(0.01)***	**$t_{(100)}$= 79.26, p=.000*****
Dining group size	**-5.12 *(1.67)***	**$t_{(91)}$= -3.07, p=.003****	Dining group size	**-8.54 *(2.96)***	**$t_{(100)}$= -2.88, p=.005****
Covariance explained by model	*Within-subjects*	**97.59%**	**Covariance explained by model**	*Within-subjects*	**97.51%**
	Between-subjects	**99.49%**		*Between-subjects*	**99.73%**

^ *Bolded variable **level**= reference level*

* *Indicates a statistically significant (p<0.05) estimate of the mean*

** *Indicates a statistically significant (p<0.01) estimate of the mean*

*** *Indicates a statistically significant (p<0.001) estimate of the mean*

Amount consumed (beverage).[66] The beverage consumed model (grams) in Table 21 accounted for 77% of the within- and 87% of the between-subjects covariance (Table 30, Appendix H). Interactions containing *social familiarity* (one of the two main IVs of interest) accounted for 0% of the within- and 64% of the between-subjects covariance.[67] Floor plan openness was not significant in the model.

Table 21 displays main effects of *gender*, *social interaction*, and *amount of beverage served*. An increase in amount of beverage served (grams) was associated with an increase in beverage consumed.[68]

[66] Beverages offered to participants were contained in a diet soda can, regular soda can, or water bottle, each with its own respective weight of liquid. Because a serving trip was defined by serving one beverage container and no participant served more than one beverage per trip (i.e., all participants who made two beverage serving trips served two beverages), the beverage grams consumed variable was not truly a continuous variable.

[67] Covariances were calculated using the same formula displayed in Appendix H. Covariance explained by social familiarity and associated interaction terms was calculated by subtracting the covariance explained by the model without those terms from the covariance explained by the full model.

[68] When controlling for all other model variables, participants consumed 100% of the beverage (grams) that they served.

Table 21. Mixed Model Results for Amount of Beverage Consumed *(grams^^)*

BEVERAGE Consumed (*grams*)		
Variable *(levels)^*	***Estimate (SE)***	***t-test Results***
Intercept	-66.07 *(38.52)*	$t_{(78)}$= -1.72, *p*=.090
SOCIAL FAMILIARITY *(strangers/**friends**)*	-64.79 *(37.93)*	$t_{(59)}$= -1.71, *p*=.093
Gender *(male/**female**)*	**115.87 *(28.91)***	**$t_{(49)}$= 4.01, *p*=.000*** **
Social interaction *(low/**medium**)* *(low/**high**)*	-75.68 *(40.06)* **-122.70 *(35.10)***	$t_{(49)}$= -1.89, *p*=.065 **$t_{(49)}$= -3.50, *p*=.001** **
Beverage served (grams)	**1.05 *(0.05)***	**$t_{(105)}$= 19.87, *p*=.000*** **
SOCIAL FAMILIARITY x Gender	**-100.65 *(36.32)***	**$t_{(49)}$= -2.77, *p*=.008** **
SOCIAL FAMILIARITY x Social interaction	**143.56 *(48.17)*** **209.44 *(47.19)***	**$t_{(58)}$= 2.98, *p*=.004** ** **$t_{(73)}$= 4.44, *p*=.000*** **
Covariance explained by model	*Within-subjects*	**77.20%**
	Between-subjects	**86.79%**

^ *Bolded variable **level**= reference level*
CAPITAL LETTERS= *one of 2 main IVs of interest*
^^ Only regular soda contained calories, so no model was generated for beverage calories consumed.
*** Indicates a statistically significant (p<0.01) estimate of the mean*
**** Indicates a statistically significant (p<0.001) estimate of the mean*

Examining interactions: Pairwise comparisons for beverage consumed (grams). Pairwise comparisons conducted on significant interactions in the total beverage consumed model (grams), using Bonferroni adjusted alpha levels as noted,[69] are displayed in Tables 21a – 21b.

- *Social familiarity x gender* (Table 21a). Pairwise comparisons indicated that males consumed more beverage than females overall, but results were only significant for friends (476.11 male friends v. 360.24 female

[69] Unless otherwise noted, mean and pairwise comparisons for the total calories of beverage consumed (grams) model variables were conducted using a mean of 470.05 grams of beverage served.

friends grams). Female participants dining with strangers consumed more beverage than females dining with friends (413.12 v. 360.24 grams), but those differences and differences between male strangers and friends (428.33 v. 476.11 grams) were insignificant. Results suggested that female beverage consumption may be influenced by the presence of friends, and possibly by dining companions of the opposite gender.

Table 21a. Pairwise Comparisons for the Interaction Between Social Familiarity and Gender on Total Beverage Consumed *(grams)*

Gender	Social familiarity		Bonferroni adjusted alpha level
	Strangers	Friends	
Male	428.33 [ac]	476.11 [aD]	.05/4=.0125
Female	413.12 [bc]	360.24 [bD]	

*"**AA**, **BB**" etc. indicate significant pairwise comparisons (p> alpha level)*
"aa, bb" etc. indicate insignificant pairwise comparisons (p< alpha level)

- *Social familiarity x social interaction* (Table 21b). Participants dining with strangers consumed less beverage during high levels of social interaction than low or medium levels (369.19 high v. 437.06 low v. 455.92 medium grams), but results were not significant. The opposite occurred for participants dining with friends, however, who consumed significantly fewer beverages with medium and significantly more beverage with high levels of social interaction (408.62 low v. 361.60 medium v. 484.30 high grams). Strangers also consumed significantly more beverage than friends with medium levels of social interaction (455.92 v. 361.60 grams). All other pairwise comparisons were insignificant.

***Table 21b. Pairwise Comparisons for the Interaction Between Social Familiarity and Social Interaction on Total Beverage Consumed** (grams)*

Social familiarity	Social interaction			Bonferroni adjusted alpha level
	Low	Medium	High	
Strangers	437.06^{abg}	455.92$^{ac\mathbf{H}}$	369.19$^{bc\mathbf{I}}$	.05/9=.006
Friends	408.62^{deg}	361.60$^{d\mathbf{FH}}$	484.30$^{e\mathbf{FI}}$	

*"**AA**, **BB**" etc. indicate significant pairwise comparisons (p> Bonferroni adjusted alpha level)*
"aa, bb" etc. indicate insignificant pairwise comparisons (p< Bonferroni adjusted alpha level)

<u>Amount consumed (total food and beverage)</u>. The model for total amount consumed in grams (combined food and beverage) accounted for 85% of the within- and 96% of the between-subjects covariance (Table 30). Interactions containing *social familiarity* accounted for 0% and 52%, respectively, of the within- and between-subjects covariances.[70] Floor plan openness was not a significant predictor. The left side of Table 22 displays main effects of *gender*, *social interaction*, and *total amount served*. An increase in total amount of grams served was associated with an increase in amount (grams) consumed.[71]

The total calories of food and beverage consumed model accounted for 97% of the within- and 99% of the between-subjects covariances (Table 31). Neither floor plan openness nor social familiarity was a significant predictor in this model. Table 22 (right side), however, indicates significant main effects of *education level*, *gender*, *total calories served*, and *dining group size*. Graduate students consumed more calories of total food and beverage than

[70] Covariances were calculated using the same formula displayed in Appendix H. Covariance explained by floor plan openness, social familiarity, and their associated interaction terms was calculated by subtracting the covariance explained by the model without those terms from the covariance explained by the full model.
[71] When controlling for all model variables, participants consumed 100% of food (grams) served (average dining group size = 5.92).

undergraduate students (700.24 v. 665.43 calories). Male students consumed more total calories than female students (694.21 v. 671.45 calories). An increase in total calories served was associated with an increase in food calories consumed;[72] calories consumed decreased with an increase in dining group size from three to seven (712.47 – 671.88 calories).

[72] When controlling for all model variables, participants consumed 96% of the food calories served (average dining group size = 5.92).

Table 22. Mixed Model Results for Total Amount Consumed *(grams and calories)*

TOTAL Consumed (*grams*)			TOTAL Consumed (*calories*)		
Variable *(levels)^*	***Estimate (SE)***	***t-test Results***	***Variable*** *(levels)^*	***Estimate (SE)***	***t-test Results***
Intercept	-102.07 *(41.92)*	$t_{(71)}$= -2.44, p=.017	Intercept	**74.27 *(28.08)***	**$t_{(109)}$= 2.65, p=.009****
SOCIAL FAMILIARITY *(strangers/**friends**)*	-80.64 *(41.97)*	$t_{(59)}$= -1.92, p=.059	Education level *(undergrad/**grad**)*	**-34.81 *(12.93)***	**$t_{(60)}$= -2.69, p=.009****
Gender *(male/**female**)*	**116.26 *(32.43)***	**$t_{(51)}$= 3.59, *p*=.001****	Gender *(male/**female**)*	**22.76 *(10.16)***	**$t_{(61)}$= 2.24, *p*=.029***
Social interaction *(low/**medium**)* *(low/**high**)*	-84.17 *(44.22)* **-118.74 *(38.87)***	$t_{(49)}$= -1.90, *p*=.063 **$t_{(49)}$= -3.06, *p*=.004****	Total served (calories)	**0.96 *(0.01)***	**$t_{(107)}$= 65.12, *p*=.000*****
Total served (grams)	**1.05 *(0.04)***	**$t_{(100)}$= 28.77, *p*=.000*****	Dining group size	**-10.15 *(3.57)***	**$t_{(94)}$= -2.84, *p*=.006****
SOCIAL FAMILIARITY x Gender	**-96.11 *(40.19)***	**$t_{(49)}$= -2.39, *p*=.021***			
SOCIAL FAMILIARITY x Social interaction	**170.25 *(53.00)*** **225.33 *(51.11)***	**$t_{(59)}$= 3.21, *p*=.002**** **$t_{(74)}$= 4.41, *p*=.000*****			
Covariance explained by model	*Within-subjects*	**85.22%**	**Covariance explained by model**	*Within-subjects*	**96.94%**
	Between-subjects	**95.93%**		*Between-subjects*	**99.38%**

^ *Bolded variable **level**= reference level*
CAPITAL LETTERS= *one of 2 main IVs of interest*
* *Indicates a statistically significant (p<0.05) estimate of the mean*
** *Indicates a statistically significant (p<0.01) estimate of the mean*
*** *Indicates a statistically significant (p<0.001) estimate of the mean*

<u>Examining interactions: Pairwise comparisons for total food and beverage consumed (grams)</u>. Pairwise comparisons conducted on significant interactions in the total food and beverage consumed model (grams), using Bonferroni adjusted alpha levels as noted,[73] are displayed in Tables 22a - 22b.

- *Social familiarity x gender* (Table 22a). Pairwise comparisons indicated significant differences between male and female friends. Males dining with friends consumed significantly more total food and beverage than females dining with friends (833.16 v. 716.89 grams). Females dining with strangers consumed more than females dining with friends while males dining with friends consumed more than males dining with strangers, but neither differences were significant.

Table 22a. Pairwise Comparisons for the Interaction Between Social Familiarity and Gender on Total Consumed *(grams)*

Gender	Social familiarity		Bonferroni adjusted alpha level
	Strangers	Friends	
Male	788.27[ac]	833.16[aD]	.05/4=.0125
Female	768.11[bc]	716.89[bD]	

*"**AA**, **BB**" etc. indicate significant pairwise comparisons (p> alpha level)*
"aa, bb" etc. indicate insignificant pairwise comparisons (p< alpha level)

- *Social familiarity x social interaction* (Table 22b). Pairwise comparisons indicated that participants dining with strangers during low and medium levels of social interaction consumed significantly more total food and beverage than participants dining with strangers during high levels of social interaction (800.04 low, 820.56 medium v. 713.97 high grams).

[73] Unless otherwise noted, pairwise comparisons for the total consumed (grams) model variables were conducted using a mean total amount served (grams) of 847.49.

Participants dining with friends during high levels of social interaction, however, consumed significantly more than participants dining with friends during medium levels of social interaction (842.66 v. 723.92 grams). During medium levels of social interaction, participants dining with strangers consumed significantly more total food and beverage than participants dining with friends (820.56 v. 723.92 grams). Conversely, during high levels of social interaction, participants dining with strangers consumed significantly less than participants dining with friends (713.97 v. 842.66 grams). Results suggested that lower levels of social interaction were associated with an increase in total grams of food and beverage consumed among participants dining with strangers, but a decrease among participants dining with friends.

***Table 22b. Pairwise Comparisons for the Interaction Between Social Familiarity and Social Interaction on Total Consumed** (grams)*

Social familiarity	Social interaction			Bonferroni adjusted alpha level
	Low	Medium	High	
Strangers	800.04^{aBg}	820.56^{aCH}	713.97^{BCI}	.05/9=.006
Friends	758.49^{deg}	723.92^{dFH}	842.66^{eFI}	

*“**AA**, **BB**” etc. indicate significant pairwise comparisons (p> Bonferroni adjusted alpha level)*
“aa, bb” etc. indicate insignificant pairwise comparisons (p< Bonferroni adjusted alpha level)

Potential mediating relationship

Although floor plan openness and social familiarity were not significant in seven of thirteen models generated, analyzing associations between floor plan openness, serving trips, amount served, and amount consumed revealed a potential mediating relationship between the latter three variables, and possibly floor plan openness, that warrants further study. Floor plan openness was a significant predictor in the number of serving trips model; number of serving trips was a significant predictor in the amount served model; and amount served was a significant predictor in the amount consumed model (Figure 24). The association between serving trips and amount consumed was absent when including amount served in the model, which suggests that amount served was a mediator between serving trips and amount consumed (Baron & Kenny, 1986; Wells, et al., 2007). Floor plan openness potentially indirectly influenced amount served and consumed in this study, via this mediating relationship, by significantly affecting serving trips.

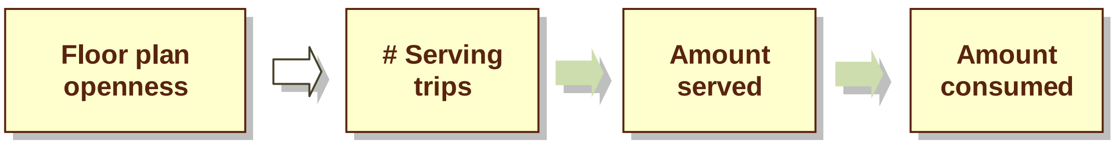

Figure 24. Potential mediating relationship between floor plan openness, serving trips, amount served, and amount consumed.

Using partial derivatives, an approximation of how much floor plan openness affected serving trips, amount served, and amount consumed in this study sample was calculated for total food and beverage calories (See Appendix I).[74] Participants with a BMI, for example, that was equal to the study sample's average BMI (22.632), made 0.39 more total food and beverage serving trips and consumed 67.30 more calories in the open versus closed condition. Furthermore, with each additional serving trip, participants served an additional 181.20 calories and consumed an additional 173.94 calories (96% of calories served).

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[74] Appendix I contains four sets of equations and example approximations for total food (see *1. grams* and *2. calories*) and, as discussed above, for total food and beverage (see *3. grams* and *4. calories*).

CHAPTER 4

DISCUSSION

Summary

The primary objective of this study was to explore the effects of kitchen floor plan openness and social familiarity on eating behaviors within a simulated residential kitchen environment. The following sections discuss findings from this study relating to main effects of floor plan openness and social familiarity; the interaction between floor plan openness and social familiarity; and linear mixed model results. The potential relationship between openness, serving trips, amount served, and amount consumed is also further discussed, in addition to strengths, limitations, and implications of this research, as well as suggestions for future research.

Kitchen Floor Plan Openness

Question 1: *Do people make more serving trips, serve more, and consume more food and beverage in an open versus closed residential kitchen floor plan?* Previous research, although not focused at the room scale which would be useful to architects, has found that increased salience and convenience of food was associated with an increase in amount served and consumed (Painter, et al., 2002; Sobal & Wansink, 2007; Wansink, 2004; Wansink, Painter, et al., 2006), but no prior studies have examined the effects of kitchen floor plan openness and salience on eating behaviors, or the relationship between serving trips and amount served and consumed. Results summarized in Table 23 supported the hypothesis that participants would make significantly more *total food serving trips* and *total food and beverage* *serving trips*[75] in the open condition where food and beverage were more salient (see pp. 34-39). Participants also made more beverage serving trips in the open versus closed condition, but the difference was not significant. Kitchen floor plan openness did not significantly affect the *amount of food and beverage served* or *consumed* as expected.

Table 23. Main Effects of Kitchen Floor Plan Openness

	Dependent Variable (D.V.)				
	Serving Trips	Amount Served		Amount Consumed	
D.V. Item	*#*	*grams*	*calories*	*grams*	*calories*
Pasta **Salad** **Dressing** **Dessert** **Soda-Regular** **Soda-Diet** **Water**	*(no significant results)*				
TOTAL Food	√	-	-	-	-
TOTAL Beverage	-	-	-	-	-
TOTAL	√	-	-	-	-

√ = Significant (p<0.05) main effect of kitchen floor plan openness on D.V. item
- = No significant effect (p>0.05)

The increase in serving trips in the open condition could have been explained by the increased salience, and perhaps perceived convenience, of food and beverage when compared to the closed condition. Participants in the open condition were able to view food and beverage during the entire meal,[76] which may have cued them to get up from the table more frequently than participants in the closed condition and serve additional food and beverage. During the closed condition sessions, participants may have also perceived

[75] Participants did not, however, make significantly more trips for individual food and beverage items, perhaps because sample sizes for each individual item were smaller (not everyone served every item).
[76] Participants could view the food and beverage in the kitchen (or screens in the closed condition) both directly and via a mirror behind the television.

the food and beverage as less convenient to obtain because they had to navigate around the screen between them and the food and beverage.

As illustrated in Table 23, findings did not support hypotheses regarding influences of kitchen floor plan openness on *amount served* or *amount consumed*. The effects of kitchen floor plan openness were only significant for *food, and total food and beverage serving trips*, perhaps because obtaining servings of food and beverage required a negotiation of the built environment, or kitchenscape. The amounts served and consumed, however, were likely more affected by serving food-, plate-, and tablescapes (serving bowls and containers, serving container and utensil sizes, and the layout of food and beverages), and dining food-, plate-, and tablescapes (tablecloth, plates, bowls, utensils, beverage containers), respectively, in addition to influences of the social environment, individual participant factors, and modifications to kitchen floor plan openness within the kitchenscape (Sobal & Wansink, 2007, 2008). This may serve as a possible explanation for the lack of significant effects of floor plan openness on amount served or consumed: amounts of food and beverage served and consumed were affected more by the table-, plate-, and foodscapes than modifications to the kitchenscape (open v. closed). Because the latter three "scapes" did not vary, no significant differences in amount served or consumed were found.

Another possible explanation may have been that influences of the built and social environments partially canceled out one another. Amounts served and consumed may have been affected by floor plan openness, but participants were also affected by self-presentation and felt "on display." Despite making more serving trips in the open condition, participants may not have served more because their dining companions could observe their plates upon returning to the table, causing participants to feel “on display” and serve less. Future studies could examine eating behaviors of individual participants to determine if floor plan openness affects amounts served and consumed.

Social Familiarity

Question 2. Do participants make more serving trips for, serve more, and consume more food and beverage when dining with friends v. strangers? Because previous research suggested that friends dining together were less affected by conformity and self-presentation than strangers dining together (Clendenen, et al., 1994; Salvy, et al., 2007), participants dining with friends were expected to make more serving trips, serve more, and consume more than participants dining with strangers. Findings, however, did not support this hypothesis.

Table 24. Main Effects of Social Familiarity

	Dependent Variable (D.V.)				
	Serving Trips	Amount Served		Amount Consumed	
D.V. Item	*#*	*grams*	*calories*	*grams*	*calories*
Pasta	√	-	-	-	-
Salad	√	√	√	√	√
Dressing	-	-	√	√	√
Dessert	√	√	√	√	√
Soda-Regular	-	-	-	-	-
Soda-Diet	-	-	n/a	-	n/a
Water	-	-	n/a	-	n/a
TOTAL Food	√	√	√	√	√
TOTAL Beverage	-	-	-	-	-
TOTAL	√	-	√	-	√

√ = *Significant ($p<0.05$) main effect of social familiarity on D.V. item*
\- = *No significant effect ($p>0.05$)*

Self-presentation and conformity may have influenced friends more than strangers. Results (see pp. 40-45), summarized in Table 24, indicated that participants dining with strangers, not friends, made significantly more *serving trips* for pasta, salad, dessert, total food, and total food and beverage; *served* more *salad* (grams and calories), *salad dressing* (calories only), *dessert* (grams and calories), *total food* (grams and calories), and *total food and beverage* (calories only); and *consumed* more *salad* (grams and calories), *salad dressing* (grams and calories), *dessert* (grams and calories), *total food* (grams and calories), and *total food and beverage* (calories only). With the exception of dessert, all other food and beverage items offered to stranger and friend dining groups were exactly the same. Desserts offered to stranger dining groups differed slightly ("cookies and crème" snack size candy bars v. plain milk chocolate pieces) from those offered to friend dining groups due to availability. Participants dining with strangers verbally commented about the desserts during sessions and frequently asked to take extra dessert home with them upon completion of study sessions, while participants in the friend condition made no comment or similar request. Although there was no statistically significant difference between the number of friend and stranger dessert serving trips, preference for the two candies offered likely accounted for how much dessert was served and consumed.

Because participants dining with strangers and sharing free meals together neither knew each other nor expected to see each other again, they may have been less affected by self-presentation and conformity, and more concerned with obtaining extra credit or serving and consuming free food and beverage. College students may have also been more comfortable dining with strangers than members of a residential household. Or, since people usually eat alone or with a friend or someone with whom they are familiar, especially within a residential setting, dining with strangers perhaps engendered anxiety and increased participants' dining with strangers serving trips, amount served, and amount consumed.

Another possible reason why friends did not make more serving trips, serve more, or consume more than strangers may have related to the operationalization of social familiarity within groups (i.e., construct validity). Neither the friend nor the stranger dining groups contained all close friends or all complete strangers. Participants in the friend condition were recruited from an undergraduate lecture class. There were no strangers[77] in these dining group sessions, but 50% indicated that they recognized a classmate, 24% recognized a friend, and 26% recognized both a classmate and friend. Because some participants were peers rather than close friends, they may have been more affected by conformity and self-presentation than close friends or family, as previous studies have indicated (Clendenen, et al., 1994; de Castro, 1994a). Similarly, strangers dining together were not all true strangers. Fifty-two percent indicated that they recognized no one, 21% recognized a classmate, 20% recognized a friend, and 7% recognized both a classmate and friend. While there were no strangers in the friend dining groups, there were some friends as well as classmates in the stranger dining groups.

Another explanation may have been that participants dining with friends both were more familiar with each other and conversed more[78] during the meal than strangers dining together, leaving them less time to serve and

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[77] Strangers were defined as participants who reported in their survey responses that they recognized "no one."
[78] Observations of session social interaction, rated from 0 (low or no social interaction) to 2 (high social interaction), indicated that, on average, friends dining together (0.95) were more socially interactive than strangers dining together (0.57).

consume food and beverage. Friends dining together were also observed to wait for everyone else to serve themselves before beginning to eat, which further reduced available time to serve and consume food and beverage when compared to stranger dining groups. Friends may have also perceived that they should serve themselves less to leave enough food and beverage for their dining companions, whereas strangers may have been less concerned by this. Also, because college students may be more accustomed to eating with strangers than residents of a home, study participants dining with strangers may have been less affected by conformity and self-presentation than anticipated. Any of these explanations could have contributed to an increase in strangers' number of serving trips, amount served, and amount consumed when compared to friends dining together.

Pliner and colleagues (2003) suggested that increased consumption among participants dining with multiple companions occurs because of extended meal times often associated with people dining together rather than individually, even though their study found that multiple dining companion groups still consumed more than individuals even during fixed meal times. Their suggestion, however, may have been relevant during the present study. Based on observations, friends dining together may not have consumed more than strangers because of the fixed meal time. Had groups been allowed to determine the meal duration, friends may have behaved according to expectations and made more serving trips, served more, and consumed more than friends because of additional time available to engage in eating behaviors, in addition to socializing.

Interaction Between Kitchen Floor Plan Openness and Social Familiarity

Question 3: Is there an interaction between kitchen floor plan openness and social familiarity on eating behaviors? Friends were expected to be less affected by conformity and self-presentation and therefore make more serving trips, serve more, and consume more than strangers, especially in the open condition where food and beverage were more salient and perhaps perceived more convenient to access. However, this hypothesis was only partially supported by significant interactions (see pp. 46-60) found on *total beverage serving trips*, as illustrated by Table 25. Both strangers and friends made significantly more total beverage serving trips in the open versus closed condition, but friends dining together also made significantly more total beverage serving trips than strangers in the open condition, as hypothesized. This may have been because friends dining together, especially undergraduate college students, culturally associated obtaining beverages with socializing.

Table 25. Kitchen Floor Plan Openness by Social Familiarity Interaction

	Dependent Variable (D.V.)				
	Serving Trips	Amount Served		Amount Consumed	
D.V. Item	*#*	*grams*	*calories*	*grams*	*calories*
Pasta	-	-	-	-	-
Salad	-	-	-	-	-
Dressing	-	-	-	-	-
Dessert	-	-	-	-	-
Soda-Regular	√	√	√	√	√
Soda-Diet	-	-	n/a	-	n/a
Water	-	-	n/a	-	n/a
TOTAL Food	-	-	-	-	-
TOTAL Beverage	√	-	√	-	√
TOTAL	-	-	-	-	-

√ = Significant ($p<0.05$) interaction on D.V. item
- = No significant interaction ($p>0.05$)

Significant interactions between kitchen floor plan openness and social familiarity were also found on *regular soda serving trips*, *grams of regular soda served* and *consumed*, and *calories of regular soda (total beverage) served* and *consumed*. Contrary to hypotheses, strangers, not friends, made more serving trips and served and consumed significantly more grams and calories of regular soda in the open versus closed condition. This may have been because strangers dining together were less affected by self-presentation. Strangers may have been less concerned by how their dining companions perceived their higher-calorie beverage selection, leading them to make more serving trips for, serve, and consume more higher-calorie regular soda. Another possible explanation may have been that people consider soda in a different realm than actual food and, therefore, behaved differently. Influences of the built and social environments were observed to operate separately for beverages and food.

How Effects of Kitchen Floor Plan Openness and Social Familiarity Vary by Personal and Demographic Variables

Question 4: Do the effects of kitchen floor plan openness and social familiarity on eating behaviors vary by education level, gender, hunger, social interaction, ethnicity, income, housing type, age, body mass index (BMI), or dining group size? While previous research has found that obesity can be moderated by all of the above factors, this study's non-representative sample of college students was expected to only experience differences in eating behaviors based on gender, hunger, social interaction, BMI, and dining group size. Males, hungrier participants, participants in more socially interactive dining groups, participants with higher BMI, and participants in larger dining groups were expected to make more serving trips, serve more, and consume more food and beverage than females, less hungry participants, participants with less socially interactive dining groups, participants with lower BMI, and participants with smaller dining group sizes. No differences in education level, ethnicity, income, housing type, or age were expected because of low variability in these variables within the college student sample.[79] The thirteen models generated controlled for the above variables and explored interactions between them and floor plan openness and social familiarity, the two main IVs of interest. Table 26 summarizes the results of all thirteen models; however, the following discussion focuses on the six linear mixed models and associated post-hoc tests in which floor plan openness and social familiarity were significant predictors of number of food serving trips, number of beverage serving trips, number of total serving trips, total amount served (grams), beverage consumed (grams), and total amount consumed (grams).

The three serving trips models (serving trips for food, beverage, and total food and beverage) explained the least covariance of all models, but were also the only models, with the exception of total grams served, that included kitchen floor plan openness as a significant predictor.

Food serving trips. When controlling for education level, gender, social interaction, BMI, dining group size, and a gender by dining group size interaction[80] (Table 26), kitchen floor plan openness, social familiarity, and their associated interaction terms accounted for a modest 27% and 31% of the within- and between-subjects covariances. Because the full model only

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[79] Results found significant effects of education level in 10 of the 13 models. This effect was likely due to differences in motivation to participate, discussed on page 106.
[80] Hunger was not a significant predictor in the food, beverage, or total food and beverage serving trips models.

accounted for 36% and 57% of the within- and between-subjects covariances, other factors not included in the model likely influenced food serving trips. Graduate students most likely made significantly more food serving trips than undergraduate students because of differences in motivation to participate in the study: "starving graduate students," as one participant explained, attended study sessions to obtain free food, while most undergraduate students[81] gained extra credit in classes for their participation.

[81] Only 2 of the 21 undergraduate students in the friend conditions signed up to receive $15 compensation; the remaining undergraduate students received extra credit.

Table 26. Summary of Linear Mixed Models Generated for Serving Trips, Amount Served, and Amount Consumed

Model Variables	1-Floor plan openness	2-Social familiarity	3-Education level	4-Gender	5-Hunger	6-Social interaction	7-BMI	8-Dining group size	9-Other predictors	Interaction terms
Levels	*Open/ Closed*	*Friends/ strangers*	*Undergrad/ Grad*	*Male/ female*	*No/yes*	*Low/med/ high*	*18.4-32.6 (avg. 22.6)*	*3-7*	*No levels: continuous variables*	*Refer to numbers for levels*
Serving Trips										
Food	√ x	√ x	√	√ x	-	x	x	√ x	-	1x2; 1x7; 2x6; 4x8
Beverage	√ x	√ x	-	√ x	-	-	√ x	-	-	1x2; 1x7; 4x7
Total	√ x	√ x	√	√ x	-	x	x	x	-	1x7; 2x6; 2x8; 4x8
Amt Served										
Food (grams)	-	-	√ x	√ x	√	-	-	-	x-Food serving trips	3x4; 3x9
Bev (grams)	-	-	√ x	-	-	√ x	-	-	√ x-Bev serving trips	3x9; 6x9
Total (grams)	√ x	-	√ x	x	√ x	-	-	-	√-Total serving trips	1x4; 3x5
Amt Served										
Food (cals)	-	-	√ x	√	√ x	-	√ x	-	√ x-Food serving trips	3x5; 7x9
Total (cals)	-	-	√	√	√	-	x	-	√ x-Total serving trips	7x9
Amt Consumed										
Food (grams)	-	-	√	√	-	-	-	√	√-Food served (grams)	-
Bev (grams)	-	x	-	√ x	-	√ x	-	-	√-Bev served (grams)	2x4;2x6
Total (grams)	-	x	-	√ x	-	√ x	-	-	√-Total served (grams)	2x4; 2x6
Amt Consumed										
Food (cals)	-	-	√	√	-	-	-	√	√-Food served (cals)	-
Total (cals)	-	-	√	√	-	-	-	√	√-Total served (cals)	-

√ *Indicates a statistically significant ($p<0.05$) predictor* - *Indicates a statistically insignificant ($p>0.05$) predictor*

x *Indicates a predictor within a statistically significant two-way interaction term, displayed in the "Interaction terms" column*

Pairwise comparisons for the *floor plan openness by social familiarity* interaction term found that strangers made significantly more serving trips in the open versus closed condition, and that strangers made more trips than friends in the open condition. This indicated that strangers dining together, not friends as hypothesized, were more affected by floor plan openness. Strangers dining together may have made more food serving trips in the open versus closed condition because of the increased salience and perceived convenience of food and beverage, and little or no effects of conformity and self-presentation. Participants dining with strangers interacted less overall, and potentially did not expect to ever see each other again. Observations, especially of groups that did not interact, indicated that participants were more interested in obtaining their compensation ($15, extra credit, or free food), rather than socializing to make friends or assess their dining companions. Friends dining together may have made fewer food serving trips than strangers because friends were more affected by conformity and self-presentation. These results, however, could have been confounded by the fact that no graduate students, who made significantly more food serving trips than undergraduate students, were present among friends dining together. If graduate students making several trips were present during the friend condition, they may have cued undergraduate participants to increase their serving trips as well (i.e., conformity), or influenced social interaction during sessions.

The interaction between *floor plan openness and BMI* indicated that the increase in food serving trips in the open versus closed conditions was only significant for participants with higher BMIs (22-32), consistent with hypotheses. Participants with lower BMIs (19-21) also made slightly more food serving trips in the open versus closed condition, but the difference was not significant.[82] While some research has found that participants with higher BMIs may be more affected by environmental influences than those with lower BMIs (Wrigley, et al., 2003), a larger sample size and more variability in BMI is needed in the current study to further explore these results.

The interaction between *social familiarity and social interaction* revealed that high levels of social interaction were associated with more food serving trips among strangers dining together, but also with fewer food serving trips among friends dining together. These results also suggest that friends may have been more affected by conformity and self-presentation than strangers in this study, even during high levels of social interaction when more trips were anticipated. Findings also suggest that higher levels of social interaction were not necessarily associated with less time to make food serving trips since strangers dining together during high levels of social interaction made almost twice as many food serving trips as friends. High levels of social interaction could have served as a distraction (Sobal & Wansink, 2007, 2008; Wansink, 2004) for strangers, but low levels were associated with more trips, perhaps because there was less distraction and less time spent socializing. Medium levels of social interaction may provide enough distraction and time to be associated with lower numbers of food serving trips among both strangers and friends.

The *gender by dining group size interaction* suggested that, although males made more food serving trips than females overall, the relationship depended on dining group size. Females made significantly more food serving

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[82] Participants with a BMI of 18 made approximately the same number of food serving trips in both the open (1.51) and closed (1.53) conditions.

trips than males, contrary to hypotheses, in dining group sizes of three to five, but males made more food serving trips than females in groups of six and seven, although results were insignificant. Males may have been affected by self-presentation more in larger groups. They could have felt the need to make more trips and appear more masculine by obtaining more food. Alternatively, they could have perceived that there may be less food available when more people were present, and therefore made more serving trips. Crowding could have also influenced food serving trips. In larger dining group sizes of six and seven, females may have felt more crowded than males, limiting their food serving trips.

Beverage serving trips. When controlling for gender, BMI, and a gender by BMI interaction (Table 26), kitchen floor plan openness, social familiarity, and associated interaction terms accounted for 17% and -38%,[83] respectively, of the within- and between-subjects covariance. Because the full model only accounted for 17% and 21% of the within- and between-subjects covariances, other factors not included in the model such as the unit effect[84] (Geier, Rozin, & Doros, 2006) may have affected beverage serving trips.

Pairwise comparisons for the *floor plan openness by social familiarity* interaction found that friends made more beverage serving trips than strangers in the open condition, as hypothesized. Friends also made more beverage serving trips in the open versus closed condition. This may have been

[83] The positive within-subjects covariance indicated that as participants went from the closed (coded as 0) to open condition (coded as 1), beverage serving trips increased. The negative between-subjects covariance implied that participants dining with strangers (coded as 0) made more serving trips than friends (coded as 1).
[84] Consuming the entire contents of one beverage container.

because friends dining together, especially undergraduate college students, culturally associated obtaining beverages with socializing.

The *floor plan openness by BMI* interaction effect on beverage serving trips was similar to the interaction effect on food serving trips (see p. 109). In support of hypotheses, increased beverage serving trips in the open versus closed conditions were only significant for participants with BMIs between 24 (instead of 22) and 32. A g*ender by BMI* interaction, however, was only significant in the beverage serving trips model. Males served significantly more than females only among participants with BMIs between 24 and 32.

Total serving trips. Floor plan openness, social familiarity, and associated interactions accounted for 34% and 19% of the within- and between-subjects covariances, while the full total serving trips model explained 47% and 46% of the within- and between-subjects covariances. Graduate students, who made more food serving trips than undergraduate students, also made more total food serving trips.

The *floor plan openness by BMI interaction*, as in both of the food and beverage serving trips models, also supported hypotheses in the total serving trips model. Participants with BMIs between 21 and 32 experienced an increase in total serving trips in the open condition when compared to participants with BMIs between 18 and 20. Likewise, the s*ocial familiarity by social interaction* pairwise comparisons yielded the same results in the total serving trips model as in the food serving trips model (see p. 110).

Social familiarity by dining group size was only significant in the total serving trips model. Participants dining with strangers made significantly more total serving trips than friends dining together in groups of three, four, five, and six, but not seven. This may have occurred because the majority of strangers dining together participated in the study in order to receive free food and were less affected by conformity and self-presentation, contrary to hypotheses.

Gender by dining group size was also significant in the total serving trips model, but females only made significantly more total serving trips than males in groups of three, four, and five. Males made more serving trips than females in groups of six and seven, but results were insignificant. The same possible explanations for these findings in the food serving trips model apply to the total serving trips model (see p. 110).

Amount served (total food and beverage - grams). Floor plan openness and a floor plan openness by gender interaction explained 14% and -8% of the within- and between-subjects covariances when controlling for education level, gender, hunger, total serving trips, and an education level by hunger interaction. The full model accounted for 66% and 41% of the within- and between-subjects covariances. The *floor plan openness by gender* interaction was only significant in this model. Males served significantly more total grams of food and beverage than females, but only in the open condition. Females also served significantly less in the open versus closed condition. This may have been due to the effects of self-presentation. Female participants could have been more conscious of being seen while serving food in the open condition and therefore served less.

The *education level by hunger* interaction was significant in the total amount of grams served and also the food calories served models. In the total grams served model, both hungry graduate and undergraduate students served more than their non-hungry dining companions. Hungry graduate students also served significantly more than hungry undergraduate students. This difference was also likely attributed to differences in motivation to participate in the study (see p. 107). Findings indicated that hunger was only a significant predictor in amount served models (amount of food served, total amount served, food calories served, and total calories served), but not in any serving trips, or surprisingly, amount consumed models.[85] Hypotheses anticipated that hunger would be a strong predictor of food and beverage consumed but results suggested otherwise. This is discussed later in the future research section (see p. 125).

Total beverage consumed (grams). This model accounted for 77% of the within- and 87% of the between-subjects covariances. Two significant interactions containing social familiarity, the between-subjects IV, accounted for 64% of the between-subjects covariance. The *social familiarity by gender* interaction was only significant in this and the total amount of food and beverage consumed models. Males consumed more beverages than females, but only among participants dining with friends and not strangers. The effects of self-presentation may have been experienced by both male and female participants dining with friends rather than strangers as hypothesized.

The interaction between *social familiarity and social interaction*, significant in two of the serving trips models, was also significant in the total beverage grams consumed model, but pairwise comparison results differed. Participants dining with friends during high versus medium levels of social interaction consumed more grams of beverage. Strangers dining together consumed more beverage than friends dining together during medium levels of social interaction, but the reverse occurred during high levels. This may have been because of the normative association between consuming a

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[85] This evidence is supportive of the need to examine influences of floor plan within the kitchenscape and not just factors within table-, plate-, and foodscapes.

beverage and socializing among friends, or because higher levels of social interaction served as a distraction among participants dining with friends and prevented them from monitoring beverage intake.

Total amount consumed (grams). Two significant interactions containing social familiarity accounted for 0% and 52% of the within- and between-subjects covariances, while the complete total amount of food and beverage consumed model accounted for 85% of the within- and 96% of the between-subjects covariances. The *social familiarity by gender interaction* was similar to the beverage served (grams) model. Males consumed significantly more total grams than females, but the difference was only significant among participants dining with friends. Pairwise comparisons for the interaction between *social familiarity and social interaction* revealed similar results for friends dining together during high and medium levels of social interaction, and strangers and friends dining together during both medium and high levels of social interaction (interaction 110). Participants dining with strangers, however, consumed more total food and beverage (grams) during low and medium versus high levels of social interaction. Lower levels of social interaction were associated with an increase in total grams of food and beverage consumed among participants dining with strangers, but a decrease among participants dining with friends. This supported hypotheses that friends dining together would be less affected by self-presentation and conformity and consume more during high levels of social interaction (a distraction).

Potential mediating relationship. This relationship revealed that participants consumed 67.30 more calories in the open versus closed condition when controlling for other significant predictors. Considering that studies recommend reducing daily caloric intake by 50 to 100 calories, and that Americans consume approximately two-thirds of their total daily calories from meals prepared at home (Guthrie, et al., 2002; Wells & Rollings, under review), these results revealed strong implications for altering residential kitchen environments to assist residents with losing or maintaining weight.

Approximations also indicated that study participants with lower BMIs experienced little or no difference in serving trips, amount served, and amount consumed between the open and closed conditions. Conversely, study participants with higher BMIs experienced the most difference between open and closed conditions. They also served less food and beverage with each additional serving trip, but made more serving trips overall. Future studies with larger sample sizes and more variability in BMI should investigate differences in eating behaviors among participants with varying BMIs.

This potential mediating relationship, however, is based only on data from this study and requires further analyses to test the significance of the mediating relationship (Holmbeck, 2002). Differences in calorie consumption also cannot entirely be attributed to kitchen floor plan openness. Future studies with much larger sample sizes and more variability in BMI are needed. Furthermore, a nonlinear model may more accurately describe the present study’s data than the linear models utilized for analyses.

Strengths

Utilizing a test kitchen and simulating a residential kitchen environment, rather than conducting a field study, strengthened the internal validity of this study. Potential confounding variables present in residential environments, such as differing floor plans, people present, and ambient environmental characteristics, remained constant. This setting afforded researchers control of the built environment so that the only environmental difference between the open and closed conditions was the placement of the screen. Additionally, keeping participants naïve to the study's true purpose reduced the likelihood that their eating behaviors were modified during the study. Data collection and analyses also measured and included multiple demographics and between-subjects factors.

This study contributed to the literature in five ways. First, it was the only study, to the author's knowledge, that empirically investigated the influences of open and closed residential kitchen floor plans on eating behaviors. Second, this study examined influences of the built environment on dietary intake beyond the neighborhood scale by exploring the effects of residential kitchen floor plan openness on eating behaviors. Third, the study examined food and beverage serving trips, in addition to amount served and consumed, to explore how eating behaviors were affected by a change in the built environment. The open and closed floor plans each required a different negotiation of the built environment. Findings suggested that open kitchen floor plans were associated with a higher number of serving trips, but analyses of floor plan openness and amount served and consumed found no significant results. Fourth, results revealed an interaction between BMI and floor plan openness, which was surprising for such a narrow range and non-representative sample of college students. Results concerning BMI may also, with future research, suggest two underlying mediators: self-regulatory skills and self-awareness of satiation. Fifth, the potential mediating relationship between floor plan openness, serving trips, amount served, and amount consumed had not been previously explored. Understanding how this relationship and built and social elements influence eating behaviors can further contribute to literature concerning influences on obesity within residential settings.

Limitations

Despite the strengths of this study, several research design and study sample, data collection, and data analyses limitations must be noted.

Research design and study sample. Although the order in which participants attended open and closed conditions was counterbalanced, this study's relatively small sample of participants was neither randomly selected, nor randomly assigned to stranger and friend dining groups. The sample also contained entirely Cornell University students, with limited variability in age, ethnicity, income, housing type, and BMI, who dined in a simulated residential kitchen, which greatly limits the generalizability of results. The manipulation of floor plan openness was also weak. Placing screens in front of the kitchen was not the same as constructing a wall with a doorway. Watching television during the meal could also have competed with visual cues provided by the screens, even though this better simulated a meal in a residential setting. Results pertaining to social familiarity were furthermore confounded by the fact that there were no graduate students present in the friend dining groups, and stranger and friend dining groups were not all true strangers and friends.[86] Graduate and undergraduate students' motivation to participate in this study differed: graduate students attended to receive two free meals, but undergraduate students attended for extra credit or $15 compensation. Questionnaires did not include items to confirm and assess social familiarity

[86] Refer to discussion of stranger and friend dining groups on page 98.

levels among participants. A stronger manipulation of social familiarity would require alternative recruiting methods and questionnaire items to confirm familiarity prior to study sessions.

Participant questionnaires also did not include questions concerning participant awareness about their eating behaviors and whether or not they perceived a difference in salience or convenience, or in their serving trips, amount served, and amount consumed between the open and closed conditions. Participants were also not asked at what time they consumed their last meal. Future studies should request that all participants not eat for a few hours prior to the study session or at least inquire when exactly a meal was last consumed, but this could reveal that the study's actual purpose is about eating and not group behaviors.

Another research design limitation was that participants only attended one open and one closed dining session. In order to obtain more reliable measures of serving trips, amount served, and amount consumed, measurements should be obtained from several open and closed sessions. Also, participants in the friend dining groups were recruited from the same lecture class, taught by the director of the Food and Brand Lab within the same department. They may have had some indication that the study's purpose was to examine eating behaviors. No students from this department participated in the stranger condition.

Data collection. The same three trained researchers conducted stranger dining group data collection sessions and insured that all conditions related to session timing, the video, food preparation, layout, serving and weighing, and questionnaire completion remained the same between sessions. Friend dining group sessions, however, were conducted by an undergraduate research group as part of a class, of which only one person was fully trained. The author noted several differences when observing a few of these data collection sessions, such as study sessions not beginning on time; participants completing questionnaires during instead of after the meal; participants conversing with the researcher, who remained in the room during sessions to record food servings; and sessions being interrupted after the video began when food serving utensils were not available. These differences could have further confounded results pertaining to social familiarity because the difference between stranger and friend groups could have been attributed to differences in data collection.

Data analyses. Because of the small sample size, linear mixed models[87] generated did not explore or include any three-way interaction terms. Analyses of calories served and consumed were also challenging to interpret because the two types of salad dressings and three types of beverages[20] differed in caloric content, although participants were not aware of this difference. Participants could have served and consumed more grams of either item, but if items were diet, no calorie foods or beverages, results indicated that they served and consumed fewer calories than someone who served or consumed less weight of the higher-calorie items. Grams and calories of food and beverage were both recorded and analyzed for this reason, but utilizing a measure that accounts for both would be useful in future studies.

Beverage analyses were also difficult. Because regular soda, diet soda, and water were served in their original containers (cans or bottles), this

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[87] Using a linear mixed model procedure and multiple moderators for a small sample size may have been "over-analysis."

created a unit consumption effect (Geier, et al., 2006). People are more likely to serve themselves less of a unit item, such as a bag of chips, cookie, or can of soda, and consume the entire unit (Wansink, B.,[88] personal communication, November, 2009). The volume of the pre-packaged unit provides a cue for ceasing intake (Sobal & Wansink, 2007). Because there were only three beverages available, and each had its own fixed weight rather than varying if it were served from a pitcher, beverage serving trips and amount served variables were more categorical (no beverage, regular soda, diet soda, or water) than continuous variables. Total beverage serving trips and total beverage calories served were also categorical, because the only beverage that contained calories was regular soda. Furthermore, the amount of beverage served and consumed could also have been related to the amount of food served and consumed, but this was not explored in the current study.

Although this study presented several limitations, promising results indicated that there is likely an effect of kitchen floor plan openness on serving trips, in addition to findings regarding social familiarity, and that future studies should be conducted to further explore these effects on eating behaviors.

Implications and Potential Applications

Findings from this study, especially if explored and confirmed by future studies, suggested several important implications for residential kitchen diners trying to gain, maintain, or lose weight, and designers.

Residential kitchen diners. Studies have found that people serve and consume less when food is kept in the kitchen rather than on the dining table

[88] Cornell University Professor and Director of the Cornell Food and Brand Lab.

during a meal, or in cabinets rather than on the kitchen counter (Sobal & Wansink, 2007, 2008; Wansink, 2004). Food kept in a less-salient closed kitchen could potentially further reduce the number of serving trips during a meal and the amount served and consumed throughout the day, especially if homes do not require residents to pass through kitchens or congregate in family spaces adjoining or part of kitchen spaces.

Designers. Designers and architects of homes and school cafeterias could potentially use the findings from this and future studies to either increase or decrease food and beverage consumption. New housing designs often contain centralized and open kitchen, dining, and family room spaces. While this supports multi-tasking and provides a space for a family to gather, the arrangement may make it more difficult for residents to stay out of the kitchen. Designers could explore rearrangements of floor plans to support multitasking and efficiency, while reducing the salience and perceived convenience of kitchen access where food and beverages are stored and served. School cafeterias could also explore placing less healthy items in a separate, enclosed room and more healthy items in the same space as seating, while still considering crowding, supervision, and safety concerns.

Educating people, especially children, about environmental effects on eating behaviors may also help people lose, gain, or maintain weight. If residents know that passing through their open or centralized kitchen every day after work leads them to consume more food and beverage, they could enter through another door in their home or adjust their behaviors in other ways to better control their food and beverage consumption.

Future Research

Future research should be conducted to improve and expand upon this study by utilizing a larger, more heterogeneous sample and especially prioritizing further exploration of the interaction between BMI and floor plan openness, and the potential mediating relationship. Improving the internal validity of the experimental design by using moveable, full-height wall partitions painted to match the room would also strengthen the manipulation of floor plan openness. Furthermore, revised and additional items should be added to the questionnaire inquiring about stress and hunger (e.g., items pertaining to restrained eating).

Two additional experimental conditions could also be added to future studies. First, observing the eating behaviors of individual diners may provide more information about the effects of floor plan openness without social familiarity, and also information about dining group size. Second, adding a condition in which food and beverages are placed on the dining table, rather than in the kitchen, could better explore the effects of modifying convenience. The closed condition only required participants to take a few extra steps to navigate around the screen. Sessions could also be run with and without the video in case television viewing interacted with other study variables. Analyses could also further explore the effects of the IVs on serving trips, amount served, and amount consumed for individual food items, especially main dishes such as pasta. Examining amount served and consumed per trip, beyond average amount served and average amount consumed per average trip, may also reveal differences in serving and consumption behavior. The differences in consumption behaviors based on whether people serve food in one or two versus multiple trips could be interesting. Other non-linear statistical models may also be more appropriate for future data analyses.

Future studies could investigate the effects of seating arrangement and distance from the kitchen. Two seats during this study's data collection sessions faced away from the food, but participants in these seats viewed the kitchen (or screens in the closed condition) via one of the two-way mirrors behind the television. The remaining six participants were seated with a peripheral view of the kitchen area, but three seats faced two windows instead of at a closed door and additional two-way mirror (see table diagram, Appendix G). The distance from individual chairs to the food and beverages could also have affected serving trips, amount served, and amount consumed, in addition to whether or not participants were seated next to or across from a participant of the opposite gender. Because of the small sample size and the participants' selection of their own seats, seating arrangement was not analyzed.

Whether or not participants felt comfortable laughing during the session, enjoyed the session, and liked the food could also not be analyzed because of small sample sizes in the distribution of responses. Few participants reported that they did not enjoy the session, like the food, or feel uncomfortable laughing at the video. Future studies could explore the effects of these meal dynamics on eating behaviors as well.

Other future studies could examine the effects of fixed and non-fixed meal time lengths on individuals', friends', and strangers' eating behaviors. Because friends did not make more serving trips, serve more, or consume more than strangers, this study suggested that length of meal time may indeed be a factor affecting these behaviors.

After completing additional laboratory sessions, field studies could be conducted. Types of housing and floor plans, in addition to number and types of people within homes, could improve the generalizability of results. Further exploring the effects of the home environment on eating behaviors would greatly contribute to the literature. Previous research has investigated or discussed the effects of the home environment on eating, but most focused on parental eating and feeding styles, television viewing, portion sizes, and food and beverage salience and convenience (Chandon & Wansink, 2002; Coon, Goldberg, Rogers, & Tucker, 2001; Coon & Tucker, 2002; Fisher & Birch, 1995; Kahn & Wansink, 2004; Painter, et al., 2002; Patrick & Nicklas, 2005; Patrick, Nicklas, Hughes, & Morales, 2005; Proctor et al., 2003; Sobal & Wansink, 2007, 2008; Wansink, 1996, 2004; Wansink & Cheney, 2005; Wansink & Kim, 2005; Wansink & Van Ittersum, 2003; Wansink, Van Ittersum, et al., 2006). No studies have examined the influences of housing design, such as floor plan arrangement and kitchen placement, or increasing kitchen and kitchen and housing storage space sizes on eating behaviors. Future studies could also examine the effects of these built environmental elements on Americans, especially those who actually consume two-thirds of their daily calories at home (Guthrie, et al., 2002), and potentially generate results that could assist them in reducing caloric intake. Conversely, studies could be conducted to explore if the opposite effects can assist those who need to increase caloric intake.

Lastly, future studies should consider and explore cultural differences in both eating behaviors and housing design. Hunger was not a significant predictor of amount consumed in this study, but all participants were American residents. Other studies have found that hunger may exert a stronger influence on consumption in other cultures, such as France. French respondents indicated that they stopped eating during a meal when they were full, while Americans suggested that they ended a meal when the food was gone or others stopped eating (Wansink, 2004). Within residential settings, some cultures who typically prepare more aromatic cuisine may prefer closed floor plan arrangements to contain odors, while others may desire space for larger gatherings for meals. Influences of both social and built environmental elements on eating behaviors may differ by culture and ethnicity, which could potentially provide a partial explanation for why obesity rates can vary by ethnicity.

Conclusion

This study examined the effects of floor plan openness and social familiarity on three eating behaviors within a microsetting: the home. Obtaining food in the kitchen was a sociospatial decision, serving food was a personal and spatial decision, and consumption depended mostly upon amount served. Instead of only exploring amount of food and beverage served and consumed, number of serving trips was also observed to examine how negotiation of the built environment was affected by alterations to the kitchenscape. Findings from this study can help develop our understanding of the effects of the built environment on eating behaviors within residential settings. Results suggest implications for designers and residents dining at home. Additionally, a potential mediating relationship between floor plan openness, serving trips, amount served, and amount consumed could, if supported by future research, generate recommended modifications to residential kitchens and contribute to healthier home eating environments.

APPENDIX A

GROUP DINING SESSION SUPPLY LIST

Room

Television
DVD player
DVD (two 24-minute popular comedy show clips)
Tablecloth
Scissors
Tape
Marker

Scales

2 scales and display readers (AE Adam CPWplus 15 bench scale, 33lb/15kg capacity)
1 small scale (Pelouze battery-operated 5 lb/2.2 kg capacity scale) to pre-weigh salad dressing before and all waste after dining sessions

For participants (maximum of 8 per session)

Name tags pre-numbered 1-8 with red marker in upper right corner
Consent forms
Questionnaires
Plates (9")
Bowls (6")
Napkins
Forks
Writing utensils

Researcher (dressed as chef; records negative readings and controls video)

Chair
Apron
DVD player remote
Clipboard
Negative reading form
Writing utensils

For observers

Participant list
Observation form
Waste recording form
Writing utensils

Food from a local grocery store and serving supplies (*per session*)

3 serving bowls (for salad, dessert, shredded cheese)
Tongs for salad
Serving spoon for pasta
Small serving spoon for cheese

Pasta	1 tray baked Ziti from Wegmans
Salad	1.5 bags (16oz/454g per bag) in large bowl
Italian Dressing-Lite	8 servings (22g per cup) in small pre-weighed plastic cups
Ranch Dressing-Lite	8 servings (22g per cup) in small pre-weighed plastic cups
Cheese	½ bag (8 oz/227g per bag) in small bowl
Dessert	21 snack-sized candy pieces (~14g each) in medium bowl
Soda-Regular	8 cans (12 fl oz/355mL per can)
Soda-Diet	8 cans (12 fl oz/355mL per can)
Water Bottles	8 bottles (16.9 fl oz/500mL per can)

Clean up

Paper towels, cleaning spray, sponge, dish soap, aluminum foil, recycling and trash bags

APPENDIX B

DINING GROUP SESSION SCRIPT

When participants first enter: Please choose a seat and write your first name on your name tag. Put on your name tag and complete both copies of the consent form.

When ready to start: *(Introduce yourself)* Thanks for coming. Tonight you will watch a 24 minute video of Colbert Report skits, enjoy a meal, and complete a brief survey. You can help yourselves to as much pasta, salad, dessert, and drinks as you like already set up for you *(point to back of room)*. Because space is a little tight, we ask that you go get food one at a time. When we are finished, you can leave all paperwork and trash at your place so you can leave on time. Now, imagine that you are at someone's house to watch a television show and have dinner with a group of people. Enjoy the meal and I will see you when the video is over. *(Leave room and close door. "Chef" starts the video immediately.)*

After Video: I hope you enjoyed the session. Please complete the questionnaire.

(*As people are finishing*) Please do not tell anyone else about this study. Remember to leave trash and name tag at your place, and please do not take anything with you except for your consent form copy. Thanks and don't forget to return for the second session.

After second session: Debrief.

APPENDIX C

CONSENT FORM

Date/Time_____________ ID#____

Behavior Research Study Consent Form

What the research study is about
This research study will observe behaviors of people when in a group setting.

What you will be asked to do: You will be asked to complete a questionnaire and attend two 45 minute events that will be video-recorded, two weeks apart. The entire research study will take approximately 1.5 hours. Participation is voluntary, you may skip questions you do not want to answer, and you can withdraw at any time.

Compensation: At the end of the research study (2 sessions), you will receive extra credit, if applicable, for your participation through SUSAN and two free dinners.

Responses are confidential: Records of this research study will be kept confidential. Any publication will not include information making it possible to identify you.

Risk and benefits
There are no foreseeable risks associated with your participation in this research study. Your decision whether or not to participate will not affect your current or future relations with Cornell University.

Contact if you have questions or concerns
The researcher conducting this research study is Kim Rollings (kar243@cornell.edu). Please ask any questions you have now or contact Kim with additional questions later. Be aware that email can potentially be read by a third party. If you have any questions or concerns regarding your rights as a participant, contact the Institutional Review Board (IRB) at 607-255-5138 or access their website at http://www.irb.cornell.edu. You may also anonymously report concerns or complaints through Ethicspoint or by calling, toll free, 1-866-293-3077. Ethicspoint is an independent organization that serves as a liaison between the University and the person bringing the complaint so that anonymity can be ensured.

Consent Statement: *I read and agree to all information above; I consent to participate in this research study.*

Participant's name (printed): ________________________________ **Net ID**: _____________________

Participant's Signature ___________________________________ **Date**: ______________________

Researcher's name (printed): ____

Researcher's Signature _____________________________________ *Date*________________________

You will be given a copy of this form to keep for your records.

This consent form will be kept by the researcher for at least three years beyond the end of the research study and was approved by the University Institutional Review Board for Human Participants on 11/9/09.

Department of Design & Environmental Analysis
Cornell University, College of Human Ecology
Martha Van Rensselaer Hall Ithaca, NY 14853-4401

Contact: Kim Rollings
Telephone: 708-228-4734

APPENDIX D

QUESTIONNAIRE

Date/time **Behavior Study Questionnaire** ID#

Please complete the following information on BOTH SIDES of this page.

Please circle your gender: male female

Please circle your annual household income range *(or individual if living with roommates)*:

< $20,000 $20,000-$40,000 $40,001-$80,000 $80,001-$120,000 > $120,000

Please check your education level from the list below:

____ *Some high school*
____ *High school*
____ *Some/currently in college*
____ *Undergraduate degree*
____ *Some/currently in graduate school*
____ *Graduate degree*
____ *PhD/currently in PhD program*
____ *Other (please specify):* __________________

Please state your ethnicity: ____

Please state your age in years: ____

Please state your height in feet and inches: __________________________________

Please state your weight in pounds: ____

Please circle where you currently live: Apartment House Other____________________

Do you recognize anyone in the room? How? Friend Classmate Other__________________

Department of Design & Environmental Analysis
Cornell University, College of Human Ecology
Martha Van Rensselaer Hall Ithaca, NY 14853-4401

Contact: Kim Rollings

QUESTIONNAIRE PAGE 1

How many different people did you speak to this evening? ______________________________

What languages do you speak? ____

Did you find this video humorous? Yes No Other ___________________________________

Did you feel comfortable laughing out loud at the video? Why or why not? _________________

____

____

____

Were you hungry when you arrived this evening? Yes No

Did you enjoy dinner? Why or why not? ______________________________________

____

____

____

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Contact: Kim Rollings

QUESTIONNAIRE PAGE 2

APPENDIX E

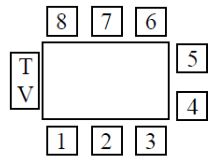
NEGATIVE SCALE READING FORM

PASTA & SALAD – NEGATIVE READINGS

Date:_________________________

participants: _________________

Open / Closed (*circle one*)



Start time:________________

End time: ________________

Video: ___________________

ID#	**Pasta**	**Salad**
	Starting Weight (g):	Starting Weight (g):

APPENDIX F

GROUP DINING SESSION OBSERVATION FORM

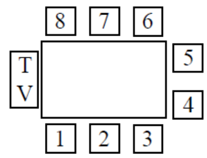
OBSERVATIONS

(Trips to kitchen for additional servings)

Date:__________________________

participants: _________________

Open / Closed (*circle one*)



Start time:________________

End time: ________________

Video: ___________________

ID	Trips	Notes
1		
2		
3		
4		
5		
6		
7		
8		

APPENDIX G

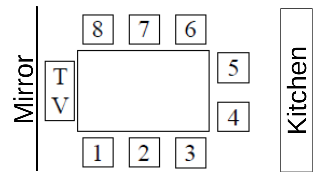
WASTE FORM

SERVED/WASTE RECORD

Date:________________________

participants: ________________

Open / Closed (*circle one*)



Start time:_______________

End time: _______________

Video: __________________

ID	**Pasta**		**Salad**		**Dressing**		**Cheese**		**Dessert**		**Soda-Regular**		**Soda-Diet**		**Water Bottles**	
	Served	Waste	Served	Waste	Served	Waste	Served	Waste	Served	Waste	Served	Waste	Served	Waste	Served	Waste
1																
2																
3																
4																
5																
6																
7																
8																

APPENDIX H

LINEAR MIXED MODEL COVARIANCE CALCULATIONS*

Table 27. Covariance Parameters for Food, Beverage, and Total Serving Trips Models

Dependent variable	Covariance type	Covariance w/out fixed effects	Covariance with fixed effects (model)	Covariance* explained by model
FOOD Serving Trips	*Within-subjects*	.285714	.181493	**36.48%**
	Between-subjects	.224675	.097595	**56.56%**
BEVERAGE Serving Trips	*Within-subjects*	.098214	.081455	**17.06%**
	Between-subjects	.030682	.021667	**21.35%**
TOTAL Serving Trips	*Within-subjects*	.419643	.231550	**47.01%**
	Between-subjects	.235552	.144587	**45.54%**

Table 28. Covariance Parameters for Amount of Food, Beverage, and Total Served Models (grams)

Dependent variable	Covariance type	Covariance w/out fixed effects	Covariance with fixed effects (model)	Covariance* explained by model
FOOD Served *(grams)*	*Within-subjects*	12238.1	7788.16	**36.36%**
	Between-subjects	22945.21	8902.04	**61.20%**
BEVERAGE Served *(grams)*	*Within-subjects*	20541.9	5308.21	**74.16%**
	Between-subjects	2079.65	1796.97	**13.59%**
TOTAL Served *(grams)*	*Within-subjects*	36058.85	12340.84	**65.78%**
	Between-subjects	27175.31	16024.26	**41.03%**

Table 29. Covariance Parameters for Amount of Food, Beverage, and Total Served Models (calories)

Dependent variable	Covariance type	Covariance w/out fixed effects	Covariance with fixed effects (model)	Covariance* explained by model
FOOD Served *(calories)*	*Within-subjects*	37513.46	21790.33	**41.91%**
	Between-subjects	70640.78	27313.45	**61.33%**
BEVERAGE Served *(calories)*	*Within-subjects*	n/a	n/a	n/a
	Between-subjects	n/a	n/a	n/a
TOTAL Served *(calories)*	*Within-subjects*	42400.18	27578.94	**34.96%**
	Between-subjects	74674.07	30520.24	**59.13%**

APPENDIX H *(continued)*

LINEAR MIXED MODEL COVARIANCE CALCULATIONS*

Table 30. Covariance Parameters for Amount of Food, Beverage, and Total Consumed Models (grams)

Dependent variable	Covariance type	Covariance w/out fixed effects	Covariance with fixed effects (model)	Covariance* explained by model
FOOD Consumed *(grams)*	*Within-subjects*	11530.96	277.75	**97.59%**
	Between-subjects	24501.18	125.47	**99.49%**
BEVERAGE Consumed *(grams)*	*Within-subjects*	25676.04	5854.90	**77.20%**
	Between-subjects	7037.51	929.76	**86.79%**
TOTAL Consumed *(grams)*	*Within-subjects*	41108.26	6075.87	**85.22%**
	Between-subjects	41364.79	1685.09	**95.93%**

Table 31. Covariance Parameters for Amount of Food, Beverage, and Total Consumed Models (calories)

Dependent variable	Covariance type	Covariance w/out fixed effects	Covariance with fixed effects (model)	Covariance* explained by model
FOOD Consumed *(calories)*	*Within-subjects*	38576.44	959.35	**97.51%**
	Between-subjects	72862.26	199.17	**99.73%**
BEVERAGE Consumed *(calories)*	*Within-subjects*	n/a	n/a	n/a
	Between-subjects	n/a	n/a	n/a
TOTAL Consumed *(calories)*	*Within-subjects*	42743.55	1307.33	**96.94%**
	Between-subjects	72030.62	479.08	**99.38%**

*COVARIANCE EXPLAINED BY MODEL CALCULATIONS:

$$\textbf{Covariance explained} = \frac{\textbf{Covariance w/out fixed effects} - \textbf{Covariance with fixed effects}}{\textbf{Covariance w/out fixed effects}}$$

APPENDIX I

PARTIAL DERIVATIVES: EQUATIONS AND CALCULATIONS

1. TOTAL FOOD (GRAMS)

Partial Derivative Equations

A	d(# serving trips)/d(open or closed)	= -1.44 + 0.5 (familiarity) + 0.06 (BMI)
B	d(amount served)/d(# serving trips)	= 8.56 + 100.96 (education level)
C	d(amount consumed)/d(amount served)	= 0.98
BxC	d(amount consumed)/d(# serving trips)	= 8.39 + 98.94 (education level)
AxBxC	d(amount consumed)/d(open or closed)	= Equation A x B x C

Example approximations

A =

-0.08	more serving trips in open v. closed for **friend=0** (BMI=22.632)
0.42	more serving trips in open v. closed for **stranger=1** (BMI=22.632)

B =

8.56	average grams served for each additional **grad=0** serving trip
109.52	average grams served for each additional **undergrad=1** serving trip[89]

C =

0.98	of every 1 gram served was consumed (97%)

B x C =

8.39	average grams consumed for each additional trip by **grad=0**
107.33	average grams consumed for each additional trip by **undergrad=1**

A x B x C = *[no graduate student (0) participants were included in the friend (0) condition]*

-8.81	more grams consumed in open v. closed for **undergrad=1, friend=0** (BMI=22.632)
3.61	more grams consumed in open v. closed for **grad=0, stranger=1** (BMI=22.632)
44.86	more grams consumed in open v. closed for **undergrad=1, stranger=1** (BMI=22.632)

2. TOTAL FOOD (CALORIES)

Partial Derivative Equations

A	d(# serving trips)/d(open or closed)	= -1.44 + .5 (familiarity) + 0.06 (BMI)
B	d(amount served)/d(# serving trips)	= 706.15 – 22.25 (BMI)
C	d(amount consumed)/d(amount served)	= 0.97
BxC	d(amount consumed)/d(# serving trips)	= 684.97 – 21.58 (BMI)
AxBxC	d(amount consumed)/d(open or closed)	= Equation A x B x C

Example approximations

A =

-0.08	more serving trips in open v. closed for **friend=0** (BMI=22.632)
0.42	more serving trips in open v. closed for **stranger=1** (BMI=22.632)

B =

202.59	average calories served for each additional serving trip (BMI=22.632)

C =

0.97	of every 1 calorie served was consumed (97%)

B x C =

196.51	average calories consumed for each additional serving trip (BMI=22.632)

A x B x C =

-16.13	more calories consumed in open v. closed for **friend=0** (BMI=22.632)
82.13	more calories consumed in open v. closed for **stranger=1** (BMI=22.632)

---

[89] Undergraduates served more per trip, but made fewer total trips than graduate students.

3. TOTAL FOOD AND BEVERAGE (GRAMS)

Partial Derivative Equations

A	d(# serving trips)/d(open or closed)	= -1.65 + 0.09 (BMI)
B	d(amount served)/d(# serving trips)	= 175.47 grams
C	d(amount consumed)/d(amount served)	= 1.05 +/- .04 = ~1 gram
BxC	d(amount consumed)/d(# serving trips)	= 175.47 grams
AxBxC	d(amount consumed)/d(open or closed)	= -289.53 + 15.70 (BMI)

Example approximations

A =
0.39 more serving trips in open v. closed (BMI=22.632)
B =
175.47 average grams served for each additional trip
C =
1.00 of every 1 gram served was consumed (100%)
B x C =
175.47 average grams consumed for each additional trip
A x B x C =
65.79 more grams consumed in open v. closed (BMI= 22.632)

4. TOTAL FOOD AND BEVERAGE (CALORIES)

Partial Derivative Equations

A	d(# serving trips)/d(open or closed)	= -1.65 + 0.09 (BMI)
B	d(amount served)/d(# serving trips)	= 532.22 – 15.51 (BMI)
C	d(amount consumed)/d(amount served)	= 0.96
BxC	d(amount consumed)/d(# serving trips)	= 510.93 – 14.89 (BMI)
AxBxC	d(amount consumed)/d(open or closed)	= -843.03 + 70.55 (BMI) – 1.34 (BMI^2)

Example approximations

A =
0.39 more serving trips in open v. closed (BMI=22.632)
B =
181.20 average calories served for each additional serving trip (BMI=22.632)
C =
0.96 of every 1 calorie served was consumed (96%)
B x C =
173.94 average calories consumed for each additional trip (BMI=22.632)
A x B x C =
67.30 more calories consumed in open v. closed (BMI=22.632)

REFERENCES

Barker, R. G. (1968). *Ecological Psychology: Concepts and methods for studying the environment of human behavior*. Stanford, CA: Stanford University Press.

Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical consideration. *Journal of Personality and Social Psychology, 51*, 1173–1182.

Bartuska, T. J., & Young, G. L. (1994). *The built environment: A creative inquiry into design & planning*. Menlo Park, CA: Crisp Publications.

Bell, R., & Pliner, P. L. (2003). Time to eat: The relationship between the number of people eating and meal duration in three lunch settings. *Appetite, 41*, 215–218.

Birch, L. L., & Fisher, J. O. (2000). Mothers' child-feeding practices influence daughters' eating and weight. *American Journal of Clinical Nutrition, 71*, 1054–1061.

Borders, T. F., Rohrer, J. E., & Cardarelli, K. M. (2006). Gender-specific disparities in obesity. *Journal of Community Health, 31*(1), 57-68.

Bray, G. A., Bouchard, C., & James, W. P. T. (1998). *Handbook of obesity*. New York, NY: Marcel Dekker.

Bronfenbrenner, U. (1979). *The Ecology of Human Development: Experiments by Nature and Design*. Boston, MA: Harvard University Press.

Bronfenbrenner, U. (1994). Ecological models of human development. In T. Husén & T. Postlethwaite (Eds.), *International Encyclopedia of Education* (2nd ed., Vol. 3). Oxford, England: Pergamon.

Brownell, K. D., Puhl, R. M., Schwartz, M. B., & Rudd, L. (2005). *Weight Bias: Nature, Consequences, and Remedies*. New York, NY: The Guildord Press.

Cahnman, W. J. (1968). The stigma of obesity. *Sociological Quarterly, 9*, 283–299.

Centers for Disease Control and Prevention. (2009). Differences in prevalence of obesity among black, white, and hispanic adults - United States, 2006 - 2008. *Morbidity and Mortality Weekly Report, 58*(27), 740-744.

Centers for Disease Control and Prevention. (2010). Statistics. Retrieved March 27, 2010, from http://www.cdc.gov/

Chaiken, S., & Pliner, P. (1987). Women, but not men, are what they eat: The effect of meal size and gender on perceived feminity and masculinity. *Personality and Social Psychology Bulletin, 13*, 166-176.

Chandon, P., & Wansink, B. (2002). When are stockpiled products consumed faster? A convenience-salience framework of postpurchase consumption incidence and quantity *Journal of Marketing Research, XXXIX (August 2002)* 321-335.

Chang, V. W., & Lauderdale, D. S. (2005). Income disparities in body mass index and obesity in the United States, 1971-2002. *Archives of Internal Medicine, 165*(18), 2122-2128.

Clendenen, V. I., Herman, C. P., & Polivy, J. (1994). Social facilitation of eating among friends and strangers. *Appetite, 23*, 1-13.

Coon, K. A., Goldberg, J., Rogers, B. L., & Tucker, K. L. (2001). Relationships between use of television during meals and children's food consumption patterns: A review of the literature *Minerva Pediatrica, 107*(1), 1-9.

Coon, K. A., & Tucker, K. L. (2002). Television and children's consumption patterns: A review of the literature. *Minerva Pediatrica, 54*(5), 423-436.

de Castro, J. M. (1990). Social facilitation of duration and size but not rate of the spontaneous meal intake of humans. *Physiology & Behavior, 47*(6), 1129-1135.

de Castro, J. M. (1991). Social facilitation of the spontaneous meal size of humans occurs on both weekdays and weekends. *Physiology & Behavior, 49*(6), 1289-1291.

de Castro, J. M. (1994a). Family and friends produce greater social facilitation of food intake than other companions. *Physiology & Behavior, 56*(3), 445–455.

de Castro, J. M. (1994b). Social faciliation of food intake: People eat more with other people. *Food & Nutrition News, 6614*, 173-174.

de Castro, J. M. (2000). Eating behavior: Lessons from the real world of humans. *Nutrition, 16*(10), 800-813.

de Castro, J. M., & Brewer, E. M. (1992). The amount eaten in meals by humans is a power function of the number of people present. *Physiology & Behavior, 51*(1), 121–125.

de Castro, J. M., Brewer, E. M., Elmore, D. K., & Orozco, S. (1990). Social facilitation of the spontaneous meal size of humans is independent of time, place, alcohol, or snacks. *Appetite, 15*(2), 89-101.

de Castro, J. M., & de Castro, E. S. (1989). Spontaneous meal patterns of humans: Influence of the presence of other people. *American Journal of Clinical Nutrition, 50*, 237-247.

DeJong, W. (1980). The stigma of obesity: Consequences of naive assumptions concerning the causes of physical deviance. *Journal of Health & Social Behavior, 21*(March), 75–87.

DeJong, W., & Kleck, R. E. (1986). The social psychological effects of overweight. In C. P. Herman, M. P. Zanna & E. T. Higgins (Eds.), *The Ontario Symposium: Vol. 3. Physical appearance, stigma, and social behavior* (pp. 65-87). Hillsdale, NJ: Erlbaum.

Dreeben, O. (2001). Health status of African Americans. *Journal of Health and Social Policy, 14*, 1-17.

Drewnowski, A., Rehm, C. D., & Solet, D. (2007). Disparities in obesity rates: Analysis by ZIP code area. *Social Science & Medicine, 65*, 2458–2463.

Engell, D., Kramer, M., Malafi, T., Salomon, M., & Lesher, L. (1996). Effects of effort and social modeling on drinking in humans. *Appetite, 26*, 129-138.

Evans, G. W., Wells, N. M., & Schamberg, M. (2010). The ecological context of SES and obesity. In L. Dube, A. Bechara, A. Dagher, D. Drewnowski, J. LeBel, J. James, D. Richard & R. Yada (Eds.), *Obesity prevention: The role of society and brain on individual behavior*. New York, NY: Elsevier.

Feldman, S., Eisenberg, M. E., Neumark-Sztainer, D., & Story, M. (2007). Associations between watching TV during family meals and dietary intake among adolescents. *Journal of Nutrition Education and Behavior, 39*, 257-263.

Fisher, J. O., & Birch, L. L. (1995). Fat preferences and fat consumption of 3- to 5-year-old children are related to parental adiposity. *Journal of the American Dietetic Association, 95*, 759-764.

Flegal, K. M., Carroll, M. D., Kuczmarski, R. J., & Johnson, C. L. (1998). Overweight and obesity in the United States: Prevalence and trends, 1960–1994. *International Journal of Obesity & Related Metabolic Disorders, 22*, 39–47.

Flegal, K. M., Carroll, M. D., Ogden, C. L., & Curtin, L. R. (2010). Prevalence and trends in obesity among US adults, 1999-2008. *Journal of the American Medical Association, 303*(3), 235-241.

Flegal, K. M., Carroll, M. D., Ogden, C. L., & Johnson, C. L. (2002). Prevalence and trends in obesity among US adults, 1999–2000. *Journal of the American Medical Association, 288*(14), 1723–1727.

French, S. A., Story, M. T., & Jeffery, R. W. (2001). Environmental influences of eating and physical activity. *Annual Review of Public Health, 22*, 309-335.

Gallagher, M. (2006). *Good food: Examining the impact of food deserts on public health in Chicago*. Chicago, IL: Mari Gallagher Research and Consulting Group.

Geier, A. B., Rozin, P., & Doros, G. (2006). Unit bias: A new heuristic that helps explain the effect of portion size on food intake. *Psychological Science, 17*(6), 521-525.

Ghirardelli, A., Quinn, V., & Foerster, S. (2010). Using geographic information systems and local food store data in California's low-income neighborhoods to inform community initiatives and resources *American Journal of Public Health, 100*(11), 2156-2162.

Gibbons, R. D., & Hedeker, D. (1994). Application of random-effects probit regression models. *Journal of Consulting and Clinical Psychology, 62*, 285-296.

Gordon-Larsen, P., Adair, L., & Popkin, B. M. (2003). The relationship between ethnicity, socioeconomic factors, and overweight: The National Longitudinal Study of Adolescent Health. *Obesity Research, 11*, 121–129.

Gortmaker, S. L., Must, A., Perrin, J. M., Sobol, A. M., & Dietz, W. H. (1993). Social and economic consequences of overweight in adolescence and young adulthood. *New England Journal of Medicine, 329*, 1008-1012.

Guthrie, J. F., Lin, B., & Frazao, E. (2002). Role of food prepared away from home in the American Diet, 1977-78 versus 1994-96: Changes and consequences. *Journal of Nutrition Education and Behavior, 34*, 140-150.

Hasell, M. J., & Peatross, F. D. (1990). Exploring connections between women's changing roles and house forms. *Environment and Behavior, 22*(1), 3-26.

Hetherington, M. M., Anderson, A. S., Norton, G. N. M., & Newson, L. (2006). Situational effects on meal intake: A comparison of eating alone and eating with others. *Physiology & Behavior, 88*, 498-505.

Hill, J. O., & Peters, J. C. (1998). Environmental contributions to the obesity epidemic. *Science, 280*(5368), 1371-1374.

Hill, J. O., Wyatt, H. R., Reed, G. W., & Peters, J. C. (2003). Obesity and the environment: Where do we go from here? *Science, 299*(5608), 853-855.

Holmbeck, G. N. (2002). Post-hoc probing of significant moderational and mediational effects in studies of pediatric populations. *Journal of Pediatric Psychology, 27*(1), 87-96.

Inagami, S., Cohen, S., Finch, B. K., & Asch, S. M. (2006). You are where you shop: Grocery store locations, weight, and neighborhoods. *American Journal of Preventive Medicine, 31*(1), 10-17.

Jeffery, R. W., Baxter, J., McGuire, M., & Linde, J. (2006). Are fast food restaurants an environmental risk for obesity? *International Journal of Behavior, Nutrition, and Physical Activity, 3*, doi:10.1186/1479-5868-1183-1182.

Kahn, B. E., & Wansink, B. (2004). The influence of assortment structure on perceived variety and consumption quantities. *Journal of Consumer Research, 30*, 519-533.

Kaiser Family Foundation. (2005). Generation M: Media in the lives of 8-18 year-olds. Retrieved December 20, 2010, from http://www.kff.org/entmedia/7251.cfm

Killingsworth, R., Earp, J., & Moore, R. (2003). Supporting health through design: Challenges and opportunities. *American Journal of Health Promotion, 18*(1), 1-2.

Koh, H., & Sadigov, S. (2010). StatNews #77: Analyzing Repeated Measures Data. Retrieved May 30, 2010, from http://www.cscu.cornell.edu/news/statnews/stnews77.pdf

Kumanyika, S. K. (1987). Obesity in black women. *Epidemiologic Reviews, 9*, 31-50.

Kumanyika, S. K. (1999). Understanding ethnic differences in energy balance: Can we get there from here? *American Journal of Clinical Nutrition, 70*, 1-2.

Kushi, L. H., Byers, T., Doyle, C., Bandera, E. V., McCullough, M., Gansler, T., et al. (2006). American Cancer Society guidelines on nutrition and physical activity for cancer prevention: Reducing the risk of cancer with healthy food choices and physical activity. *CA: A Cancer Journal for Clinicians, 56*, 254-281.

Levitsky, D. A. (2002). Putting behavior back into feeding behavior: A tribute to George Collier. *Appetite, 38*, 143-148.

Littell, R. C., Henry, P. R., & Ammerman, C. B. (1998). Statistical analysis of repeated measures data using SAS procedures. *Journal of Animal Science, 76*, 1216-1231.

Miller, A. S., & Maxwell, L. E. (2008). Exploring the role of home design in fostering family interaction: The use of programming methods in research. *Journal of Interior Design, 29*(1-2), 50-65.

Mokdad, A. H., Ford, E. S., Bowman, B. A., Dietz, W. H., Vinicor, F., Bales, V. S., et al. (2003). Prevalence of obesity, diabetes, and obesity-related health risk factors. *Journal of the American Medical Association, 289*, 76–79.

Mori, D., Chaiken, S., & Pliner, P. (1987). “Eating lightly” and the self-presentation of femininity. *Journal of Personality and Social Psychology, 53*, 693-702.

Morland, K., Wing, S., & Diez Roux, A. (2002). The contextual effect of the local food environment on residents’ diets: The atherosclerosis risk in communities study. *American Journal of Public Health, 92*, 1761–1767.

Must, A., Spadano, J., Coakley, E. H., Field, A. E., Colditz, G., & Dietz, W. H. (1999). The disease burden associated with overweight and obesity. *Journal of the American Medical Association, 282*, 1523-1529.

Ogden, C. L., Carroll, M. D., Curtin, L. R., McDowell, M. A., Tabak, C. J., & Flegal, K. M. (2006). Prevalence of overweight and obesity in the United States, 1999–2004. *Journal of the American Medical Association, 295*, 1549–1555.

Olshansky, S. J., Passaro, D. J., Herstow, R. C., Layden, J., Carnes, B. A., Brody, J., et al. (2005). A potential decline in life expectancy in the United States in the 21st Century. *New England Journal of Medicine, 352*(11), 1138-1145.

Painter, J. E., Wansink, B., & Hieggelke, J. B. (2002). How visibility and convenience influence candy consumption. *Appetite, 38*, 237-238.

Patrick, H., & Nicklas, T. A. (2005). A review of family and social determinants of children's eating patterns and diet quality. *Journal of the American College of Nutrition, 24*(2), 83-92.

Patrick, H., Nicklas, T. A., Hughes, S. O., & Morales, M. (2005). The benefits of authoritative feeding style: Caregiver feeding styles and children's food consumption patterns. *Appetite, 44*(2), 243-249.

Plante, E. M. (1995). *American Kitchen, 1700 to the Present: From Hearth to Highrise*. New York, NY: Facts on File.

Pliner, P., Bell, R., Kinchla, M., & Hirsch, E. S. (2003). *Time to eat? The impact of time facilitation and social facilitation on food intake*. Paper presented at the Pangborn Sensory Science Symposium.

Pliner, P., & Chaiken, S. (1990). Eating, social motives, and self-presentation in women and men. *Journal of Experimental Social Psychology, 26*, 240-254.

Pothukuchi, K. (2005). Attracting supermarkets to inner-city neighborhoods: Economic development outside the box. *Economic Development Quarterly, 19*, 232–244.

Powell, L. M., Auld, M. C., Cahloupka, J. F., O'Malley, P. M., & Johnston, L. D. (2007). Associations between access to food stores and adolescent body mass index. *American Journal of Preventive Medicine, 33*, S301-S307.

Proctor, M. H., Moore, L. L., Gao, D., Cupples, L. A., Bradlee, M. L., Hood, M. Y., et al. (2003). Television viewing and change in body fat from preschool to early adolescence: The Framingham Children's Study. *International Journal of Obesity, 27*, 827-833.

Puhl, R. M., Schwartz, M. B., & Brownell, K. D. (2005). Impact of perceived consensus on stereotypes about obese people: A new approach for reducing bias. *Healthy Psychology, 24*, 517-525.

Robert, S. A., & Reither, E. N. (2004). A multilevel analysis of race, community disadvantage, and body mass index among adults in the US. *Social Science & Medicine, 59*, 2421-2434.

Sallis, J. F., Bauman, A., & Pratt, M. (1998). Environmental and policy interventions to promote physical activity. *American Journal of Preventive Medicine, 15*(4), 379-397.

Salvy, S. J., Jarrin, D., Paluch, R., Irfan, M., & Pliner, P. (2007). Effects of social influence on eating in couples, friends and strangers. *Appetite, 29*, 92-99.

Schoenborn, C. A., Adams, P. F., & Barnes, P. M. (2002). Body weight status of adults: United States, 1997–98. *Advance Data, 330*, 1-15.

Sobal, J., & Stunkard, A. J. (1989). Socioeconomic status and obesity: A review of the literature. *Psychological Bulletin, 105*, 260–275.

Sobal, J., & Wansink, B. (2007). Kitchenscapes, tablescapes, platescapes, and foodscapes: Influences of microscale built environments on food intake. *Environment and Behavior, 39*, 124-142.

Sobal, J., & Wansink, B. (2008). Built environments and obesity. In E. M. Blass (Ed.), *Causes, Mechanisms, Prevention, and Treatment* (pp. 281-299). Sunderland, MA: Sinauer Associates.

Spechtenhauser, K. (Ed.). (2006). *The Kitchen*. Boston, MA: Birkhauser - Publishers for Architecture.

Story, M., Kaphingst, K. M., Robinson-O'Brien, R., & Glanz, K. (2008). Creating healthy food and eating environments: Policy and environmental approaches. *Annual Review of Public Health, 29*, 253-272.

Stroebele, N., & de Castro, J. M. (2004). Effect of ambience on food intake and food choice. *Nutrition, 20*, 821-838.

Sundquist, J., & Johansson, S. E. (1998). The influence of socioeconomic status, ethnicity and lifestyle on body mass index in a longitudinal study. *International Journal of Epidemiology, 27*, 57–63.

U.S. Department of Health and Human Services, & U.S. Department of Agriculture. (2005). *Dietary Guidelines for Americans, 2005*. Washington, DC: U.S. Government Printing Office, U.S. Department of Health and Human Services, U.S. Department of Agriculture.

Vainio, H., & Bianchini, F. (2002). *Weight Control and Physical Activity* (Vol. 6). Lyon, France: International Agency for Research Cancer Press.

Wang, M. C., Kim, S., Gonzales, A. A., MacLeod, K. E., & Winkelby, M. A. (2007). Socioeconomic and food-related physical characteristics of the neighborhood environment are associated with body mass index. *Journal of Epidemiology and Community Health, 61*, 491-498.

Wang, Y., & Beydoun, M. A. (2007). The obesity epidemic in the United States - gender, age, socioeconomic, racial/ethnic, and geographic characteristics: A systematic review and meta-regression analysis. *Epidemiologic Reviews, 29*, 6-28.

Wang, Y., & Zhang, Q. (2006). Are American children and adolescents of low socioeconomic status at increased risk of obesity? Changes in the association between overweight and family income between 1971 and 2002. *American Journal of Clinical Nutrition, 84*, 707–716.

Wansink, B. (1996). Can package size accelerate usage volume? *Journal of Marketing, 60*, 1-14.

Wansink, B. (2004). Environmental factors that increase the food intake and consumption volume of unknowing consumers. *Annual Review of Nutrition, 24*, 455-479.

Wansink, B., Cardello, A., & North, J. (2005). Fluid consumption and the potential role of canteen shape in minimizing dehydration. *Military Medicine, 170*, 871-873.

Wansink, B., & Cheney, M. M. (2005). Super bowls: Serving bowl size and food consumption. *Journal of the American Medical Association, 293*(14), 1727-1728.

Wansink, B., & Deshpande, R. (1994). "Out of sight, out of mind:" Pantry stockpiling and brand-usage frequency. *Marketing Letters, 5*(1), 91-100.

Wansink, B., & Kim, J. (2005). Bad popcorn in big buckets: Portion size can influence intake as much as taste. *Journal of Nutrition Education and Behavior, 37*, 242-245.

Wansink, B., Painter, J. E., & Lee, Y. K. (2006). The office candy dish: Proximity's influence on estimated and actual consumption. *International Journal of Obesity, 30*, 871-875.

Wansink, B., Painter, J. E., & North, J. (2005). Bottomless bowls: Why visual cues of portion size may influence intake. *Obesity Research, 13*(1), 93-100.

Wansink, B., & Van Ittersum, K. (2003). Bottoms up! The influence of elongation on pouring and consumption volume. *Journal of Consumer Research, 30*, 455-463.

Wansink, B., & Van Ittersum, K. (2005). Shape of glass and amount of alcohol poured: Comparative study of effect of practice and concentration. *British Medical Journal, 331*, 1512-1514.

Wansink, B., Van Ittersum, K., & Painter, J. E. (2006). Ice cream illusions: Bowl size, spoon size, and serving size. *American Journal of Preventive Medicine, 31*, 240-243.

Wardle, J., Farrell, M., Hillsdon, M., Jarvis, M. J., Sutton, S., & Thorogood, M. (1999). Smoking, drinking, physical activity and screening uptake and health inequalities. In D. Gordon, M. Shaw, D. Dorling & G. Davey Smith (Eds.), *Inequalities in health* (pp. 213–229). Bristol, England: Policy Press.

Wardle, J., & Griffith, J. (2001). Socioeconomic status and weight control practices in British adults. *Journal of Epidemiology and Community Health, 55*, 185–190.

Wells, N. M., Ashdown, S. P., Davies, E. H. S., Cowett, F. D., & Yang, Y. (2007). Environment, design, and obesity: Opportunities for interdisciplinary collaborative research. *Environment and Behavior, 39*(1), 1-28.

Wells, N. M., & Olson, C. M. (2007). The ecology of obesity: Perspectives from life course, design, and economics. *Journal of Hunger & Environmental Nutrition, 1*(3), 99-129.

Wells, N. M., & Rollings, K. A. (under review). *The built and natural environment: Factors in childhood obesity*. Paper presented at the Children's Health & Environment: International Workshop on Research, Policy & Practice. London, Ontario.

Winkleby, M. A., Kraemer, H. C., Ahn, D. D., & Varady, A. (1998). Socioeconomic differences in cardiovascular disease risk factors: Findings for women in the third national health and nutrition examination survey, 1988–1994. *Journal of the American Medical Association, 280*, 356–362.

Winkleby, M. A., Robinson, T. N., Sundquist, J., & Kraemer, H. C. (1999). Ethnic variation in cardiovascular disease risk factors among children and young adults: Findings from the third national health and nutrition examination survey, 1988–1994. *Journal of the American Medical Association, 281*, 1006-1013.

Wolfinger, R., & Chang, M. (1995). *Comparing the SAS GLM and MIXED Procedures for Repeated Measurements Analysis*. Cary, NC: SAS Institute Inc.

World Health Organization. (1998). *Obesity: Preventing and managing the global epidemic—report of a WHO consultation on obesity*. Geneva: WHO.

Wrigley, N., Warm, D., & Margetts, B. (2003). Deprivation, diet, and food-retail access: Findings from the Leeds ‘food deserts’ study. *Environment and Planning, 35*, 151-188.

Zhang, Q., & Wang, Y. (2004a). Socioeconomic inequality of obesity in the United States: Do gender, age, and ethnicity matter? *Social Science & Medicine, 58*, 1171-1180.

Zhang, Q., & Wang, Y. (2004b). Trends in the association between obesity and socioeconomic status in US adults: 1971 to 2000. *Obesity Research, 12*, 1622–1632.